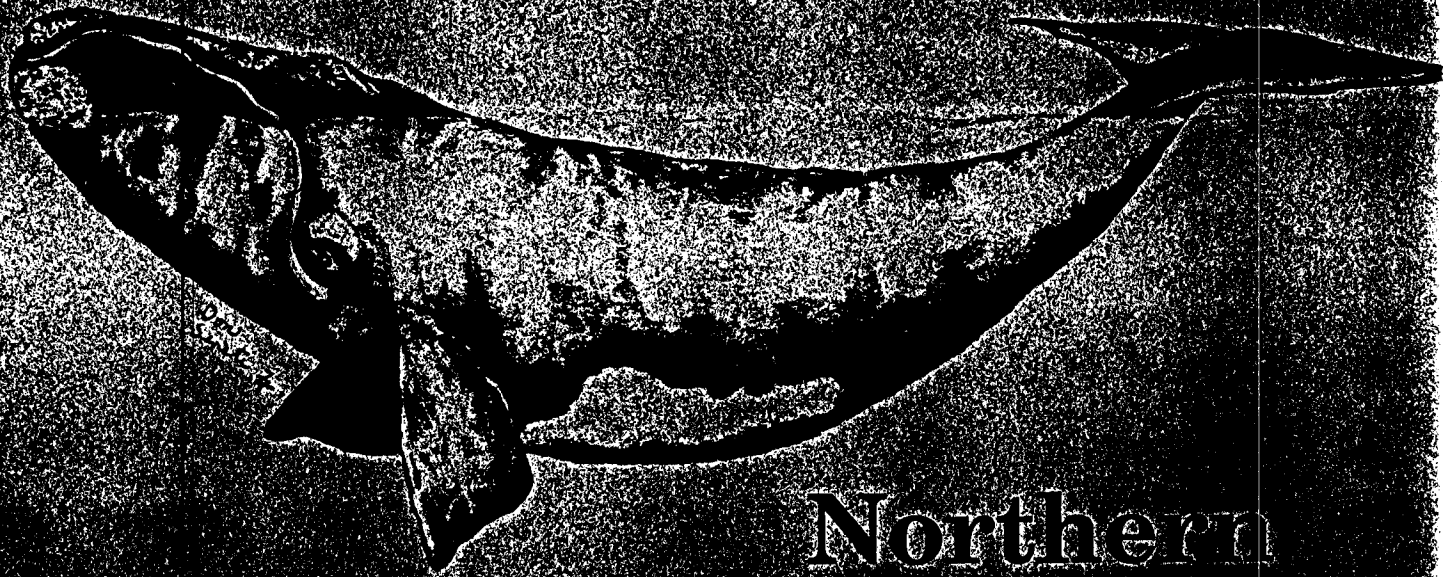


Final Recovery Plan for the



Northern Right Whale

Eubalaena glacialis

December 1991

U.S. Department of Commerce

National Oceanic and
Atmospheric Administration

National Marine Fisheries Service

Office of Protected Resources



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RECOVERY PLAN

for the

NORTHERN RIGHT WHALE *(Eubalaena glacialis)*

Prepared by the

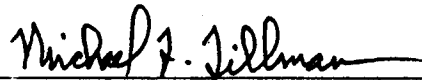
RIGHT WHALE RECOVERY TEAM

for the

**OFFICE OF PROTECTED RESOURCES
NATIONAL MARINE FISHERIES SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SILVER SPRING, MARYLAND**

December 1991

Approved:



Michael F. Tillman

Deputy Assistant Administrator for Fisheries

This Recovery Plan for The Northern Right Whale has been approved by the National Marine Fisheries Service. It does not necessarily represent official positions or approvals of cooperating agencies. It does not necessarily represent the views of all individuals involved in the plan formulation. The plan has been prepared by the Right Whale Recovery Team to delineate reasonable actions believed required to lead to the recovery of the northern right whale. This plan is subject to modification as dictated by new findings, changes in species status and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon agency appropriations and priorities.

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PREFACE

Congress passed the Endangered Species Act of 1973 (16 USC 1531 *et seq.*) (ESA) to protect species of plants and animals endangered or threatened with extinction. The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) share responsibility for the administration of the Act. NMFS is responsible for most marine mammals including the northern right whale.

Section 4(f) of the ESA directs the responsible agency to develop and implement a Recovery Plan, unless such a plan will not promote the conservation of a species. NMFS has determined that a Recovery Plan would promote the conservation of the northern right whale.

This Plan was written by the Right Whale Recovery Team at the request of the Assistant Administrator for Fisheries to promote the conservation of northern right whales. The recovery team includes experts on marine mammals from the private sector, academia and government. The members of the recovery team are listed in Appendix A.

The Team members believe that the goals and objectives of the Plan can be achieved only if a long-term commitment is made to support the actions recommended here. Achievement of these goals and objectives will require the continued cooperation of the governments of the United States and other nations. Within the United States, the shared resources and cooperative involvement of Federal, state and local governments, industry, academia, non-governmental organizations and individual citizens will be required throughout the recovery period.

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EXECUTIVE SUMMARY

The northern right whale, *Eubalaena glacialis*, is the world's most endangered large whale. Current estimates place the total number of remaining animals at no more than 600. About 350 occupy the waters of the western North Atlantic and between 100 and 300 occur in the North Pacific Ocean. The northern right whale was initially placed in this precarious position because of hunting, which started over 800 years ago and continued until the 1930's. While protected by international agreement for over 50 years, there is no evidence that the number of northern right whales has increased substantially although other large whale species, similarly protected, have shown various population increases. Both natural and human-induced factors have been suggested as responsible for this absence of measurable recovery.

This recovery plan identifies known and potential factors affecting the northern right whale and recommends actions to reduce or eliminate impacts to the northern right whale. The impacts and recommended recovery actions are presented separately for the North Atlantic and North Pacific populations.

The major threats to the North Atlantic population were identified as collisions with ships, entrapment or entanglement in fishing gear, habitat degradation and disturbance by vessels. Risks to the North Pacific population(s) are poorly known, but are presumed to be similar to those in the North Atlantic. Hunting, while not presently a problem, could reemerge as a significant problem should international prohibitions become ineffective.

While certain measures designed to assist the northern right whale are already in place, additional actions, as discussed in detail in the plan, need to be accomplished. Recovery will not be quick. It is estimated that even under the best of conditions, it will take more than 100 years for the northern right whale population to reach pre-exploitation levels in both oceans.

The plan presents an action strategy to guide a coordinated effort to allow the northern right whale the best chance of recovery based on the present state of knowledge and information. Recommended recovery actions include, but are not limited to: (1) an aggressive program of education and enforcement to reduce the risks of ship collisions and entanglement in fishing gear that entrap northern right whales, (2) the consideration of designation of three areas in the waters of the United States as "critical habitat" which are deemed to be necessary to the survival of the species, and (3) the restriction of recreational whale watching activities directed at the northern right whale. In addition to cooperation with Canadian authorities to ensure the fullest protection possible for this highly migratory species, research on many aspects of northern right whale ecology and vulnerability is needed.

Many of the recommended actions require funds; this plan recommends that priority in the allocation of these funds be given to the Western North Atlantic population. As more information is learned about the North Pacific population, a separate recovery effort is recommended for those animals. In addition, steps should be taken to coordinate and, as appropriate, combine efforts benefitting the northern right whale with other species, especially the humpback whale.

I. INTRODUCTION

The northern right whale, *Eubalaena glacialis*, is the world's most depleted species of large whale. Current estimates indicate that there are no more than 600 individuals left, with 300-350 found in the North Atlantic Ocean and 100-300 in the North Pacific Ocean. There are no other known populations of northern right whales.

The northern right whale is the large whale species that is most in danger of becoming extinct in the near future. The northern right whale's low numbers stand in alarming contrast to the other species of large whales (as summarized in Braham, 1984 and NMFS, 1991). The southern right whale (*Eubalaena australis*), numbers more than 2,000 individuals, and is increasing in at least three populations, off Australia, South Africa and Argentina (Bannister, 1990; Best and Underhill, 1990; Payne *et al.*, 1990).

Hunting is the major reason that the northern right whale has declined to this most precarious status. For a period that started more than 800 years ago and lasted well into the 20th century, the species was hunted extensively for its oil and baleen plates. The animal's commercially valuable products, its slow swimming speed, its characteristic of floating when dead and its generally coastal distribution combined to make this whale the "right" whale to kill--hence its common name. Initially, hunting was largely restricted to the eastern North Atlantic off France and Spain. As those stocks were depleted and knowledge of the world's oceans increased, hunting pressure shifted to the western North Atlantic of Labrador and New England and then to the North Pacific, eventually encompassing the species' entire range.

Observers noted that the northern right whale was susceptible to depletion as early as the 19th century. Herman Melville wrote in 1851 that, although numerous at that time, the northern right whale could vanish from the earth under the hunting pressure then being applied to it. In 1874, Scammon noted that the Pacific population was so depleted that no one knew where the animals gave birth. By 1935, the species had declined to such low numbers that the League of Nations was able to get most whaling nations to agree to stop hunting the northern right whale. Since that time, hunting or other purposeful taking has been responsible for the death of only a few additional animals, and is no longer a threat to the species. However, given over 50 years of protection, the species has not shown any recovery toward its pre-exploitation numbers. Even though population estimates are not available for the first half of this century, that could provide pre-exploitation estimates, present research techniques have not detected a significant change, either an increase or decrease, in population numbers.

In the simplest of terms, the northern right whale remains in a precarious position. The evidence discussed below strongly indicates that certain human actions continue to impede the recovery of this species. Principal among these are ship collisions, entanglement in fishing gear, degradation of the northern right whale's habitat (especially the areas where they feed), and disturbance. This recovery plan recommends specific steps that, if taken, should reduce or eliminate these human-caused injuries and deaths.

There is good reason to believe that if the full range of human actions having a negative effect on the species were reduced, the chance for the species' recovery would be maximized. However, the limitations of our knowledge of the genetic restrictions imposed upon the species by its present low numbers prevent us from declaring with certainty that the northern right whale would recover even if all potential adverse human effects were eliminated.

However, the Right Whale Recovery Team is confident that if the steps addressed in this recovery plan are taken expeditiously, we would have established optimal conditions in which the northern right whale could recover.

Detailed site-specific research and management recommendations are provided only for right whales in the western North Atlantic. Information on the distribution and occurrence of northern right whales in this area and on potential interactions with human activities, while incomplete, is sufficient to begin identifying useful research and management activities. Site-specific measures are much more limited for right whales in the North Pacific because there are no known areas where northern right whales occur predictably and sightings are scattered broadly over time and space. In the North Pacific it appears likely that natural factors, such as extremely low abundance and scattered distribution, rather than direct human threats, may pose the greatest obstacle to its recovery. Therefore, unless and until an area is identified in the North Pacific where right whales still regularly occur, potentially beneficial research and management actions appear to be very limited.

This plan recommends devoting primary attention to research and management actions for the western North Atlantic population of right whales. Research on North Pacific right whales should focus on compiling and analyzing opportunistic sighting reports and, as appropriate, surveying likely areas in the North Pacific where right whales may still occur regularly. If areas are found where right whales occur regularly in the North Pacific, development of provisions similar to those for western North Atlantic right whales could be considered.

Recovery will not be quick. Even under optimal circumstances, the recovery that has been demonstrated by other large whales such as the gray whale cannot be expected. The recovery of the northern right whale will require a very long-term commitment to be successful. Even if all of the Recovery Plan's recommendations were accepted and adequate funding, enforcement, educational programs and other needs were immediately provided, the northern right whale abundance could not be expected to increase during our lifetime to the point where the protective measures of the Endangered Species Act (ESA), including recovery efforts, can be relaxed.

II. THE NORTHERN RIGHT WHALE

A. Species Description and Taxonomy

The northern right whale, *Eubalaena glacialis* (Müller, 1776), is a robust, medium-sized baleen whale. Adults generally range in length between 45 and 55 feet and can weigh up to 70 tons. Females grow larger than males. The northern right whale's distinctive features include the absence of a dorsal fin, a large head (more than 1/4 of the body length), a narrow upper jaw and strongly bowed lower jaw. Tough cornified skin patches on the head, called callosities, are used with other marks to identify individuals. Two rows of dark baleen plates descend from the upper jaw. The plates are long (up to nine or more feet) and numerous, with about 225 on each side. The animals are generally black in color although individuals often exhibit variable white patches on the throat and belly. The tail is broad, deeply notched, and all black with a smooth trailing edge. Because of the two widely separated blowholes, its spout or blow forms a distinctive V-shape when seen from the front or back. The animals blow is a useful field characteristic for identifying a right whale from a distance. (Kraus *et al.*, 1988).

In this plan, the recommendations of Schevill (1986) will be followed and all northern right whales in both the North Atlantic and North Pacific oceans will be considered as one species, *Eubalaena glacialis* (Müller, 1776). There is a question as to whether the Atlantic and Pacific populations deserve separate recognition at the subspecific level. If such a separation is demonstrated as valid, the North Atlantic population could be referred to as *Eubalaena glacialis glacialis* (Müller, 1776) and the North Pacific population could be *Eubalaena glacialis japonica* (Gray, 1864).

The southern right whale is currently considered to be a separate but closely related species, *Eubalaena australis* (Desmoulins, 1822). The justification for keeping the two species taxonomically separate rests on skeletal data (Müller, 1954) and recently completed genetics studies (Schaeff *et al.*, 1991). However, even if they are combined, right whales of the genus *Eubalaena* will, with the possible exception of the blue whale, still be the rarest of the world's large whales and will still require a committed effort to assist their recovery.

B. Zoogeography

The pre-exploitation distribution of the northern right whale probably included the temperate and subarctic, coastal and/or continental shelf waters of the North Pacific and North Atlantic Oceans. Post-exploitation distribution--that is, since 1935--is more limited in both oceans. In general terms, the waters between Nova Scotia and Florida in the Western North Atlantic and the waters in the Gulf of Alaska (50°-58°N, 140°-152°W) appear to be the primary areas inhabited by the present northern right whale populations. The recent distribution of both North Atlantic and North Pacific populations is described briefly in Sections III.A.2 and IV.A.2. Further detail is provided in Brownell *et al.* (1986).

Because of the disjunct geographic distribution of northern right whales in the North Atlantic and North Pacific Oceans and their ocean-specific recovery needs, the plan will address the two populations separately.

C. Protective Legislation

Right whales have been protected from commercial whaling by the International Whaling Commission and its implementing legislation since 1949. In U.S. waters, northern right whales are protected by the Marine Mammal Protection Act (MMPA) and ESA. Right whales are also listed as 'endangered' (Appendix I) under the Convention on International

Trade in Endangered Species of Wild Fauna and Flora (also known as CITES), and by the Committee on the Status of Endangered Wildlife in Canada under the Cetacean Protection Regulations of Canada (Gaskin, 1987). Except for one known incident of directed take (Sergeant, 1966), international protection for this species has been followed.

Under the ESA it is a violation to 'take' (defined as; to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt any of the above) endangered species of fish or wildlife. In addition, endangered species or their parts or products may not be exported from, or imported into the United States, except for "scientific purposes or to enhance the propagation or survival of the affected endangered species." The ESA also authorizes Cooperative Agreements between states and the Federal Government for increased endangered species management, research, and law enforcement. In addition, the ESA requires all Federal agencies to consult with The National Marine Fisheries Service (NMFS) to ensure that any action taken, permitted or funded will not jeopardize the continued existence of listed species under the jurisdiction of NMFS. This requirement is a very important regulatory tool for protecting the northern right whale and its habitat because many activities that may affect the northern right whale or its habitat will be conducted, permitted, or funded by a Federal agency.

The MMPA established a national policy to protect marine mammals so that they can reach and maintain optimum sustainable population levels consistent with the maintenance of the health and stability of the ecosystem of which they are a part. The MMPA prohibits the 'take' of any marine mammal, with certain specific exceptions, in a manner similar to the ESA.

III. NORTH ATLANTIC POPULATION

A. Natural History

1. Stocks

Historical data and recent sightings suggest that the North Atlantic was inhabited by two stocks, one on each side of the ocean. However, there is no current evidence to suggest that a viable population in the eastern North Atlantic still exists, although very small numbers may remain (Brown, 1986).

2. Distribution and habitat use

Although 20th century sightings of northern right whales have been recorded from areas such as Greenland, Bermuda and Texas, observations of the western North Atlantic population are concentrated in five known 'high-use' areas: (1) coastal Florida and Georgia, (2) the Great South Channel east of Cape Cod, Massachusetts, (3) Cape Cod Bay and Massachusetts Bay, (4) the Bay of Fundy, and (5) Browns and Baccaro Banks south of Nova Scotia. Sightings also occur in waters between these five areas. Additional 'high-use' areas may exist, since recently collected photographic and genetic data indicates a segment of the population that is not often seen in the known habitats frequently (Kraus, pers. comm.).

The population appears to migrate seasonally. Generally, most of the whales spend the spring and early summer off the coast of New England, then in the latter part of the summer and fall, move to the waters off southern Canada. Some whales may remain in these northern waters throughout the winter, but most leave. A small portion of the population, consisting almost entirely of pregnant females and juveniles, migrates south in the winter to the only known calving ground for the species, the coastal waters of Georgia and northeast Florida. Winn *et al.* (1986) characterized this distribution pattern as occurring in distinct seasonal phases, although a certain amount of variability is to be expected as whales respond to changing environmental conditions including the availability of prey. Because many recommended recovery actions are both seasonally and geographically specific, these phases are described in more detail below.

Phase 1. Winter calving.

The coastal waters of the southeastern United States, and especially the shallow waters from Savannah, Georgia, south to Cape Canaveral, Florida, are a wintering ground for a small but significant part of the population. Although a few juveniles and males have been sighted in the region, most of the records of the last decade involve adult females, many of whom are accompanied by very young calves (Kraus *et al.*, 1988). The fact that at least six newborn calves have washed ashore on the southeast coast in the last 10 years adds to the evidence that these waters are an important calving ground. In addition, adult females are occasionally observed unaccompanied early in the season and later with a calf. The winter calving season appears to begin as early as September and can end as late as April. However, sporadic sightings of newborn calves have occurred in May, July and September. Peak abundance and calving appears to be from December through March. Sighting effort has not been uniform throughout the entire period, however, and further work is needed to determine more accurately when whales are present and the frequency of their occurrence. The whales seen in the southeast represent only a small portion (approximately 5-10 percent) of the total known population (Kraus, 1985). The wintering ground(s) for the remainder of the population remains unknown. It is believed that remote telemetry research will be essential in locating the wintering ground(s) for the rest of the population.

Phase 2. Northward Movement

During late winter and early spring, northern right whales begin moving north. Some cow/calf pairs move along the coast past Cape Hatteras and near the Long Island coast before passing through the Great South Channel. Other individuals wintering south of Cape Hatteras may migrate northward over deeper water. Occasional sightings near the edge of the continental shelf (ca. 600 foot depth) in early March 1980 (CeTAP, 1982) support this hypothesis.

Phase 3. Spring Feeding

During March to May most sightings are in the Cape Cod-Massachusetts Bay area and the Great South Channel on the western edge of Georges Bank. Feeding activity is the most frequently seen behavior at this time. Differences in distribution observed each year are believed due to prey abundance. It has been suggested that most of the northern right whale population moves through this area en route to summer feeding grounds to the north (Winn *et al.*, 1986).

Phase 4. Early Summer Movement North

Distribution during June and July remains unknown, although the whales may move across the Gulf of Maine to the lower Bay of Fundy and the southeastern Scotian shelf.

Phase 5. Late Summer Feeding and Breeding

Most northern right whales are found either in the lower Bay of Fundy or in an area between Browns and Baccaro Banks on the southeastern Scotian shelf from July to October.

Different age classes of northern right whales have somewhat different distributions on the summer and fall feeding grounds (Kraus and Prescott, 1982). Between 20 and 40 percent of the northern right whale sightings in the relatively protected lower Bay of Fundy are cow/calf pairs, but only two calves have been seen during 5 years of observation in the more exposed Browns/Baccaro Banks region (CeTAP, 1982; Kraus *et al.*, 1984; Kraus, unpubl. data). Certain portions of the northern right whale's range, such as the Great South Channel, may serve as mixing areas for several segments of the population (Winn, 1984).

Phase 6. Fall Departure

Northern right whales leave the northern feeding grounds beginning as early as October. They apparently move to their wintering areas without any extended pause.

The specific migration route(s) of the North Atlantic right whale are unknown. The fact that northern right whales are not restricted to the distribution model discussed above is evident because sightings of northern right whales have been made in the following areas, over the last 50 years, which lie outside the high-use areas described above and the intervening waters. Recent and future telemetry studies will further our understanding of northern right whale movements and the use of these and other areas.

Gulf of St. Lawrence - Lien *et al.* (1989) observed five individual northern right whales along the Quebec coast on the north shore of the Gulf during 13 summers of research starting in 1976.

Newfoundland - Four sightings during the last decade (Beamish, 1981; Lien *et al.*, 1989), and two from the 1950's (Sergeant, 1966) have been reported.

Greenland - One northern right whale was observed near the historic Cape Farewell whaling grounds off eastern Greenland during the North Atlantic Sightings Surveys 1987 and 1989 summer ship surveys of the North Atlantic.

New York and New Jersey Coastal Waters - In recent years, two to six northern right whales have been sighted each winter off Long Island (S. Sadove, pers. comm.) and off New Jersey beaches (Mead, 1986; Price and Kraus, pers. comm.; Schoelkopf, pers. comm.). In February 1983, an animal stranded in New Jersey was identified as a two-year old northern right whale that had first been photographed in the Bay of Fundy in 1981.

Bermuda - Payne and McVay (1971) reported sighting two northern right whales in April 1970.

Gulf of Mexico - Since 1900, there have been only two reports of northern right whales in the Gulf of Mexico, one report off the west coast of Florida and one stranding of a calf along the coast of Texas (Mead, 1986).

3. Feeding and prey selection

Feeding is consistently observed in Cape Cod Bay, Stellwagen Bank (Watkins and Schevill, 1976, 1979; Mayo, pers. comm.), the Great South Channel (CeTAP, 1982; Wishner *et al.*, 1988), Jeffreys Ledge (S. Mercer, pers. comm.), the lower Bay of Fundy (Kraus *et al.*, 1982; Gaskin, 1987), and the Scotian shelf (Brownell *et al.*, 1986). Most feeding occurs below the surface. However, surface feeding activity has been observed in Cape Cod Bay and occasionally is seen in other northern feeding areas, but has never been reported south of New York.

In the western North Atlantic, right whales feed primarily on copepods (*Calanus* spp.) and juvenile euphausiids, also known as krill (Collett, 1909; Mitchell, 1975; Watkins and Schevill, 1976; Kraus and Prescott, 1981; Brownell *et al.*, 1986; Murison and Gaskin, 1989). Descriptions of feeding behavior have been given by Watkins and Schevill (1976, 1979), Kraus *et al.* (1982) and Mayo and Marx (1990).

Several questions remain about feeding strategies and energetics. Kenney *et al.* (1986) calculated the daily feeding rate of an adult northern right whale to be at least 4.07×10^5 Kcal/day. They further calculated that the minimum prey concentration required by northern right whales to sustain this rate would have to exceed 7.57 Kcal/m³. This energy requirement estimate is undoubtedly low due to varying activity levels and duration of feeding versus foraging time. Still, this represents prey densities 19 times the estimated average concentration of *Calanus* as derived from vertical plankton tows in the Great South Channel during May of 1981 (CeTAP, 1982). It is apparent that to meet their energy requirements, northern right whales concentrate on patches of zooplankton and not the water column average. Great South Channel northern right whale distribution is correlated with the occurrence of extremely dense *Calanus* patches (Wishner, *et al.*, 1988). The question of the availability of prey species concentrations necessary to sustain larger numbers of northern right whales in the habitat accessible to them is a key question in the recovery of this species.

4. Competition

Other plankton-eating fish occur in large numbers and may be at peak biomass levels in the Gulf of Maine. These could collectively represent significant competition for northern right whales. These fish include sand lance (*Ammodytes* spp.), herring (*Clupea* spp.), Atlantic mackerel (*Scomber scombrus*), river herrings such as shad, bluebacks and alewives

(*Alosa* spp.), menhaden (*Brevoortia tyrannus*), basking sharks (*Cetorhinus maximus*), as well as younger age-classes of many species of larger fishes.

Mitchell (1975) hypothesized that sei whales (*Balaenoptera borealis*) and northern right whales compete for the same food resources, and suggested that the northern right whale's failure to recover may be partly due to competition with sei whales, whose expanded range and number could be a result of depleted northern right whale stocks. However, observations made during the Cetacean and Turtle Assessment Program (CeTAP, 1982) indicated little overlap in the ranges of sei and northern right whales. Since 1987, however, sei whales have been frequently sighted near northern right whales in the Great South Channel during spring (R.D. Kenney, pers. comm.). The combination of increased sei whale competition in historic northern right whale areas and the current high biomass of planktivorous fish species in the Gulf of Maine should be considered as possible limiting factors in right whale recovery.

5. Reproduction

Calving occurs during the winter in the coastal waters of Georgia and Florida (Kraus *et al.*, 1984; Winn, 1984; Kraus *et al.*, 1985; Brownell *et al.*, 1986). However, not all cow/calf pairs seen on the summer feeding grounds were observed the previous winter off Georgia and Florida, suggesting that other birthing areas may exist or that the survey effort was insufficient to identify them.

Calves are about 15 feet long at birth (range 12 to 18 feet), and nurse for at least 9 months. Growth is rapid, about 9 feet during the first year, 7.5 feet the second year, and 3 feet in both the third and fourth years.

Data on identified individuals show that sexual maturity can be reached as early as the fifth year and as late as age nine (Knowlton and Kraus, 1989). It is not known how long northern right whales live or remain reproductively active. Reproductively active females give birth to a single calf once every 3 to 5 years (the range is between 2 and 9 years, with an average of 3.6 years) (Knowlton and Kraus, 1989). The gestation period has not been determined. Reproductive behavior, including surface courtship groups involving three or more individuals, is observed during the spring, summer and fall.

Gross Annual Reproductive Rate (GARR) is defined as the number of first year calves as a proportion of the entire population which aids in the estimation of anticipated population growth. The International Whaling Commission Workshop on the status of right whales (Brownell *et al.*, 1986) calculated a range of theoretical GARR values from 0.07 to 0.092 based on an estimated birth rate of 0.24, a sex ratio of 0.5, and the proportion of mature adults as 0.60. These values are higher than the available data suggest, and may be biased by assumptions about population demography. The population age structure, mortality rate, and age at first reproduction must be known to determine the rate at which calves are born. Since the population is small there may be a smaller proportion of mature animals (about 0.40). If these conditions apply to the North Atlantic right whale population, GARR will approach 0.048, as follows:

$$\begin{aligned}\text{GARR} &= (\text{birth rate}) (\text{sex ratio}) (\text{proportion of mature animals}) \\ &= (0.24) (0.5) (0.4) \\ &= 0.048.\end{aligned}$$

This estimate is in line with observed North Atlantic data (Kraus *et al.*, 1985, Knowlton and Kraus, 1989), but additional data are needed to support the basic assumptions.

6. Natural mortality

Rates and causes of natural mortality are poorly documented, although 7 (3 percent) of the 260 photo-identified northern right whales have scars indicative of killer whale attacks.

Sightings of cows with newborn calves along the southeast U.S. coast can be compared with the cow/calf pairs in northern feeding areas (Bay of Fundy and Cape Cod Bay) in the spring and summer to obtain an estimate of 6-month survival rates. Analysis of resighting data of whales first observed as calves indicates the mortality rate is 17 percent in the first year of life, and averages about 3 percent over the second through fourth years (Kraus, 1990). The adult mortality rate is likely to be very low as is the case for other large whale species. Ten out of the 25 (40 percent) documented mortalities reported in the 21-year period between 1970 and 1990 were calves or neonates less than 20 feet in length. While only four (16 percent) of the documented mortality records were individuals longer than 40 feet (Table 2).

7. Abundance and trends

Because hunting began more than 800 years ago, no accurate information on pre-exploitation numbers exists. For the purposes of setting a recovery plan goal, the western North Atlantic population is estimated to have been at least 10,000 animals. This figure is based on a literature search on the history of northern right whale exploitation. Hunting pressure (see Section III-B-4) reduced the population to very low numbers. The present estimated abundance of 350 animals (Kraus and Kenney, pers. comm.) indicates that no significant upward trend has occurred since hunting pressure ceased.

Increased research effort on large whales along the northeast U.S. coast since 1975 has resulted in an increase in northern right whale sightings, which may not correspond to actual population growth. Historical evidence indicates that northern right whales are no longer abundant in portions of their historic range, e.g., the Strait of Belle Isle, Newfoundland, the coastal waters of Long Island, New York, and Delaware Bay as described in Reeves and Mitchell (1986 a & b). The suggestion is that the species may only be able to survive in only a portion of its historic range.

B. Human Impacts

1. Vessel interactions

a. Collisions with ships

Northern right whale behavior such as resting at the surface, surface skim feeding, and surface courtship groups makes them susceptible to collisions with vessels. These behaviors occur sometimes for periods of an hour or more. Twenty-seven northern right whale mortalities have been documented between 1970 and 1990 as strandings or floating carcasses in the North Atlantic (Table 2). Six deaths (22 percent) could be attributed to ship collisions. An additional two deaths may have been due to ship collisions, but the necropsy reports are inconclusive. Gaskin (pers. comm.) reported six minor collisions with small craft (less than 50 feet in length) in the Bay of Fundy during the past 8 years.

Questions have been raised about whether stranded northern right whales cut by ships' propellers were struck while alive or after death from other causes. A stranding on August 7, 1986, in Massachusetts was examined by biologists from the New England Aquarium and the Center for Coastal Studies (CCS). A necropsy showed that the whale was alive when struck, and probably died instantly from a shattered spine (G. Early, pers. comm.). CCS biologists first observed the whale floating dead (with gashes) 3 days before

it was examined. At the time of the necropsy (presumably 4 days after death), the skin of this whale was already starting to blister and peel, revealing the white subdermal blubber layer. Therefore, a whale floating dead for more than 3 days (depending to a certain extent upon water temperature) can be expected to lose extensive amounts of skin. All photographs of northern right whales thought to have died from ship collisions show skin that is intact and not decomposed. In addition, dead right whales observed at sea, float ventral side up with their tails and heads hanging downward. Northern right whales struck by ships have either been struck dorsally (two cases) or had their tails severed (three cases), body areas that would be nearly inaccessible to a ship's propeller if the whales had been floating dead. Therefore, it is likely that these whales were killed by ship collisions, and were not struck after death from other causes (Kraus, 1990).

In addition to those whales struck and killed, 11 percent of 200 appropriately photographed northern right whales in the New England Aquarium's photographic catalog show signs of major wounds, indicating that they have been hit by ships or their propellers (Kraus, 1988 & 1990).

b. Disturbance from vessels

Data on the effects of vessel disturbance on either individual animals or segments of the population are not conclusive. Observations by Watkins (1986) in the Cape Cod Bay area indicated that northern right whales usually did not react to low amplitude engine noise or minor vessel maneuvering. Northern right whale responses to vessels are apparently dependent on the behavior in which they are engaged. Courtship and surface feeding are examples of behaviors during which northern right whales appear unresponsive to the approach of boats (Mayo, Watkins, and Kraus, pers. comm.). Cows with calves and single long-diving whales appear to be more sensitive to sound, and have been observed to avoid boats (Kraus and Mayo, unpubl. data).

Northern right whale areas in the Great South Channel and Bay of Fundy are located in or near shipping lanes. The effects of interactions in these areas are not documented. However, despite the extreme harassment and hunting during the historic exploitation period (Reeves, pers. comm.), right whales were observed returning to the same areas.

Northern right whales are the subject of commercial whale watching and scientific research; the heaviest concentration of these activities occurs in two areas, Cape Cod Bay in the late spring and the lower Bay of Fundy in the late summer and fall. Commercial whale watching vessels operate in Cape Cod Bay from April 15 until October. Northern right whales are rarely present in Cape Cod Bay after May 15, an exception being 1986, when several animals were resident all summer. One research vessel works Cape Cod Bay on good-weather days during the winter and spring. Non-commercial vessel activity does not usually increase in the Bay until May 31. Northern right whales are present in the Fundy region from mid-July through October. In the Bay of Fundy, six whale watching vessels operated during August 1989 (two of which selectively worked on northern right whales) and five vessels operated during August 1990 and 1991 (one of which selectively worked northern right whales each year) (Kraus, pers. comm.). In addition, research vessels operate in the area from mid-July to mid-October. However, because of poor weather, whale watching activities can only be conducted for about 30 days during this time period. There is some interest in commercial whale watching in Georgia-Florida waters during the winter.

Vessel traffic associated with outer continental shelf (OCS) activities might affect the northern right whale either at the site of the activity or while support vessels are transiting to and from these sites. Several studies are in progress along the Atlantic OCS which may address these concerns.

2. Entrapment and entanglement in fishing gear

Since 1975, twelve encounters with fishing gear have been recorded in the western North Atlantic (Table 1). Analyses of photographic data from the New England Aquarium's photographic catalog show that 58 percent of the catalogued northern right whales have scars and injuries around the tail stock indicative of rope and net cuts. Photographs of one whale that had netting wrapped around its tail stock for more than 4 years illustrate the extensive chafing and scarification which is characteristic of entanglement survivors (Kraus *et al.*, 1984; Kraus, 1990). Entanglement and entrapment in gillnets and lines from lobster pots, seines, and fish weirs have been recorded. Three whales are known to have died from entanglements (Table 2). However, one whale, Stars, lost the rope that had been caught in her baleen from 1987-1990 and gave birth to a calf in 1991 (Kraus and Katona, pers. comm.).

3. Habitat degradation

The general degradation of coastal marine habitats may ultimately be the most important factor affecting recovery of the northern right whale.

While there are no exploratory or development activities currently underway in the western North Atlantic, the U.S. Department of Interior's Minerals Management Service does plan, as part of its 5-year outer continental shelf oil and gas leasing program, to offer tracts for lease in the North Atlantic, Mid-Atlantic and South Atlantic Planning Areas along the east coast of the United States. A draft plan for exploratory drilling off the coast of North Carolina is currently under review. In addition to oil and gas leasing, the potential for hard mineral mining exists, especially for phosphates off the North Carolina, South Carolina and Georgia coasts. The impacts of industry-related noise, ship traffic, and other activities on the northern right whale are poorly known. Observations of bowhead whales off Alaska and gray whales off Alaska and the West Coast indicate that these species may exhibit avoidance behavior to activities associated with oil and gas exploration. The data also suggest that both species tolerate considerable noise levels that are constant over time (Malme *et al.*, 1989; Richardson *et al.*, 1983). The applicability of these findings to the northern right whale is not known.

Several municipalities adjacent to Massachusetts and Cape Cod Bays have proposed plans to extend untreated wastewater discharge pipes further offshore into Bay waters. The Commonwealth of Massachusetts, the U.S. Environmental Protection Agency, and the U.S. Army Corps of Engineers have designated dump sites, and are considering designation of other dredge material dump sites in Cape Cod Bay and near Stellwagen Bank. No comprehensive coordinated studies are being conducted or planned to examine the effects of these and proposed activities on northern right whales or the marine environment important to them.

Extensive dredging activities at Wilmington, North Carolina; Savannah, Brunswick, and Kings Bay, Georgia; and Canaveral, Florida, have been underway during the winter in the only known calving grounds. A permanent dumping site is located at 30°32'32"N; 81°18'00"W, south of St. Marys channel (Georgia-Florida border). The effects of dredging and disposal activities on the distribution of northern right whales need to be studied.

There have been no recent sightings of northern right whales in Delaware Bay, an area where cow/calf pairs were formerly hunted (Lipton, 1975). It is not clear if the absence from Delaware Bay and other areas once frequented by northern right whales (such as the New York Bight and Long Island Sound) is due to: (a) exclusion by human activities (Reeves *et al.*, 1978); (b) habitat degradation; (c) extinction of an independent breeding group or population segment that used the area; (d) the lack of current observer effort;

- (e) contraction of the species' range as the number of whales has decreased; or
- (f) decline/absence of prey species (Basta *et al.*, in press), or (g) natural phenomena which may have changed the physical characteristics of an area.

The seasonal use of Cape Cod Bay and Great South Channel may result from the opportunities to feed on dense plankton patches. Northern right whales may leave these areas when plankton densities fall off, and not when vessel activities in the area increase. On the other hand, vessel activity could dissipate plankton patches. In 1986, when a small number of northern right whales were the only large whale species seen in the Cape Cod area, vessel activity around the animals was often continuous in daylight hours. Although short-term disturbances were rarely reported, it is not known if the animals were able to gain optimal benefit from the habitat. The historic precedent of northern right whales remaining in areas where hunting was continuous indicates that food availability may be a driving force in the northern right whales use of an area.

In addition, seasonal immigration of large schools of planktivorous fish may reduce the density of plankton patches. Investigating and understanding patterns of habitat use is difficult and complex. Therefore, determining any cause-and-effect relationships between changes in habitat and northern right whale recovery will also be important. In addition, pollution has affected the coastal environment in varying degrees throughout this century (Champ *et al.*, 1981) and plankton, as the base of most marine food chains, has also been affected. The effects may not be measurable with standard plankton survey methods, but may be manifested by less dense or fewer plankton patches.

4. Hunting

North Atlantic right whales were hunted as early as the 1100's by the Basque whalers (Aguilar, 1986). The eastern North Atlantic stock may have been brought to near-extinction by the Basques and subsequent whaling efforts in the late 1800's and early 1900's off the British Isles (Collet, 1909; Schevill and Moore, 1983; Brown, 1986). Aguilar (1986) estimated that Basque whalers working in Newfoundland took 20,000 right and bowhead whales in approximately equal numbers between 1530 and 1610. This whaling effort along the Labrador coast may have extirpated the western North Atlantic right whale in that region by the late 1600's. Basque whaling activities ceased by the late 1600's, apparently due to reduction of the northern right whale population, and the conscription of the whalers and their ships into the Spanish navy (Barkham, 1977).

The history of hunting northern right whales along the U.S. coast from the 1600's to the 1900's is still being pieced together. However, it is known that northern right whales were hunted during that time in the waters off eastern Canada (Reeves and Mitchell, 1986a); near Cape Cod and Nantucket, Massachusetts (Starbuck, 1878; Allen, 1916); Long Island, New York (Reeves and Mitchell, 1986b); New Jersey and in Delaware Bay (Lipton, 1975); and Georgia and Florida (Schevill and Moore, 1983). Reeves and Mitchell (1986a) compiled a cumulative pelagic catch history for *Eubalaena* in the North Atlantic. Catch records for the key initial whaling period before the mid-1800's are incomplete and contain essentially no information from 1715-1760. The authors could not demonstrate any "peak decade" of catches followed by a steep decline in catch that would indicate that a larger pre-exploitation population existed.

C. Recovery Actions

1. Conservation efforts

Legislation providing protection to the northern right whale is described in section II.C. NMFS has also published guidelines that recommend the use of conservative methods of whale watch vessel operation and call for extreme caution when near northern right whales. The North Atlantic Marine Mammal Association has recommended that no more than one whale watch vessel approach any northern right whale group at a time, and suggested viewing time be limited to 10 minutes on cow/calf pairs. Whale watch vessel captains have generally cooperated in following these recommendations.

Northern right whales are on the endangered species list of several coastal states, and have been declared the State Marine Mammal for both Massachusetts and Georgia. Massachusetts has enacted legislation which prohibits the approach, within 500 yards, of northern right whales without a permit (322 Code of Massachusetts Regulations 12.00).

2. Recommended actions

This plan is intended to be updated both on a regular basis and as new information becomes available. Three-year intervals are recommended for the first 15 years and 5-year intervals thereafter. However, if significant new information becomes available in a shorter period of time, the plan should be revised accordingly in a timely manner. A body of Government and scientific representatives should be appointed to monitor, advise, and assist in plan implementation and to assist in revisions of this plan as appropriate.

The reader of this plan is asked to recognize that some of the recommended actions for the northern right whale will, if implemented, also benefit other species including the endangered humpback, fin, and sei whales. Steps should be taken to coordinate, and as appropriate, combine efforts benefiting the northern right whale and other protected species. In addition, the reader should keep in mind that some of the recommended actions can be conducted concurrently, thereby reducing costs and time needed to obtain data and results. Therefore, it is recommended that an implementation coordinator be appointed by NMFS to facilitate the carrying out of the objectives of this and other recovery and conservation plans in cooperation with other agencies (domestic and foreign) and interests.

The best available information suggests that there are about 350 animals in the North Atlantic population. The photographic catalog maintained by the New England Aquarium contains 320 different individuals, although some of them may now be dead. The pre-exploitation size of this population is uncertain as hunting began more than 800 years ago. Using available data, it is assumed for the purposes of this recovery plan that the pre-exploitation population was probably at least 10,000 animals. Although the environment which the northern right whale inhabits has changed in the last 800 years, we have no way of quantifying these changes and their ultimate effect on northern right whales and the marine environment in general. For planning purposes it is assumed the carrying capacity for the species has not changed substantially. Therefore, recovery of the western North Atlantic right whale, hypothetically, would occur when the population reaches approximately 60 to 80 percent of its estimated pre-exploitation number. This level is based on data indicating that large mammal populations reach their maximum net rate of growth at about 60 percent of their highest population size (Fowler and Smith, 1981; Fowler, 1984). Thus, an optimal sustainable population level for this population is estimated at between 6,000 and 8,000 animals. For planning purposes, the mid-point in this range, 7,000 animals, is considered as the recovery goal for the western North Atlantic population. If analysis of whaling records indicates a distinct western North Atlantic population, this level should be adjusted accordingly.

As an interim goal, this plan seeks to change the status of the population from endangered to threatened. Pending the results of studies recommended in this plan to develop a better estimate of pre-exploitation population size and carrying capacity of the existing habitat, it is recommended that a status change from endangered to threatened be considered when the following conditions are met:

- ▶ the size of the Western North Atlantic population recovers to a level of 6,000 animals;
- ▶ the population has been increasing steadily over a period of 20 years or more at an average annual net recruitment rate of at least 2 percent per year; and
- ▶ an effective program is in place to control known northern right whale mortality factors and ensure that deterioration of essential habitat is not likely to occur so as to prevent the species' continued increase toward its optimum sustainable population level.

Reproductively active females appear to rear calves successfully about once every 3 to 5 years. Given this inherently slow rate of recruitment and the small size of the western North Atlantic right whale population, it is likely that recovery to levels that would permit the changing of the status to threatened may require 150 years or more. Assuming a population size of 300 animals and constant recruitment of 2 percent per year, it would take approximately 175 years to reach a population size of 8,000 animals. If the constant net recruitment rate was 5 percent per year, that level could be reached in 69 years.

- 1226. Investigate vessel designs that reduce the probability of killing northern right whales.
- 1227. Investigate satellite capabilities for the detection of whales in shipping lanes.
- 1228. Cooperate internationally to resolve this issue.
- 123. Vigorously enforce whale-protection laws.
- 13. Reduce or eliminate injury and mortality caused by fisheries and fishing gear.
 - 131. Implement appropriate seasonal or geographic regulations for use of certain fishing gear in northern right whale habitats.
 - 1311. Bay of Fundy (Canadian jurisdiction)
 - 1312. Southern Nova Scotia Shelf (Canadian jurisdiction)
 - 1313. Jeffreys Ledge and Maine Coast
 - 1314. Cape Cod Bay and Massachusetts Bay
 - 1315. Great South Channel
 - 1316. Southeastern United States
 - 132. Improve procedures for reporting and rescuing northern right whales entangled in fishing gear.
 - 133. Develop or modify fishing gear to reduce the threat of entrapment or entanglement.
- 14. Reduce or eliminate environmental pollution that affects the northern right whale population and its habitat.
 - 141. Evaluate existing data regarding contaminant effects on northern right whales and their prey.
 - 142. Design and conduct studies to understand the effects of contaminants on northern right whales and their habitat and establish critical levels.
 - 143. Monitor the levels of the contaminants identified in 141 within the northern right whale's environment.
- 15. Continue international ban on hunting and other directed take.

OBJECTIVE 2. Maximize efforts to free entangled or stranded northern right whales and acquire scientific information from all specimens, dead or alive.

- 21. Improve and maintain the system for reporting stranded or distressed northern right whales.
- 22. Develop an improved program for handling live stranded or distressed northern right whales.

- 221. Develop a centralized system for rescuing live stranded or distressed northern right whales.
- 222. Identify areas/facilities and transportation/containment systems able to handle rehabilitation of a live northern right whale calf.
- 23. Improve the existing program to maximize data collected from dead northern right whales.
 - 231. Establish designated salvage and necropsy sites at strategic locations along the Atlantic Coast.
 - 232. Develop and distribute instructions for securing and retrieving floating carcasses of northern right whales.
 - 233. Perform comprehensive analyses of tissue samples.
 - 234. Determine causes of mortality and utilize information to reduce susceptibility to death from these causes.
- 24. Establish or identify funding sources for emergency rescue and rehabilitation efforts.

OBJECTIVE 3. Identify and protect habitats essential to the survival and recovery of the northern right whale.

- 31. Protect habitats in U.S. waters already known to be of special importance to the northern right whale.
 - 311. Florida/Georgia calving ground.
 - 312. Great South Channel spring feeding area.
 - 313. Cape Cod/Massachusetts Bay late winter feeding/nursery area.
- 32. Promote Canadian action to protect the two known critical areas in Canadian waters.
 - 321. Lower Bay of Fundy summer feeding/nursery area.
 - 322. Southern Nova Scotian shelf summer feeding area.
- 33. Periodically review the effectiveness of protective measures; update and/or revise as required.
 - 331. Provide a higher level of protection if required for any of these areas.
 - 332. Protect other essential areas identified in Section 36.
- 34. Improve knowledge of how northern right whales utilize their habitats.
 - 341. Conduct comprehensive studies of northern right whale habitat use patterns and modify habitat protection strategies as appropriate.

- 3411. Determine differences in habitat use by age, sex, reproductive status, or individual variation.
- 3412. Increase knowledge of numbers of animals present and residence times in known habitat areas.
- 3413. Determine routes and timing of migration between known high-use habitats.
- 342. Understand the feeding ecology of northern right whales in the western North Atlantic.
 - 3421. Compile and evaluate existing data on known and potential prey and competitor species.
 - 3422. Review and refine energetics models to better understand northern right whale food requirements and feeding strategies.
 - 3423. Design and conduct studies as required to fill gaps in knowledge of feeding requirements as determined in 3421 and 3422.
- 35. Characterize known habitats of special importance to the northern right whale and protect as necessary.
 - 351. Compile existing physical, chemical, biological, and meteorological data for known high-use habitats.
 - 352. Design and conduct studies as required to more accurately characterize these habitats.
- 36. Identify and protect as necessary other habitat(s) essential to the survival and recovery of the western North Atlantic right whale population.
 - 361. Locate the still unknown wintering area(s) of the population.
 - 362. Review historical catch and sighting data to identify other possible feeding, calving, or breeding areas.
 - 363. Examine existing oceanographic data for likely areas based on the results of habitat characterization studies (33).
 - 364. Design and conduct surveys of likely wintering habitats (361) and other areas (362 and 363).

OBJECTIVE 4. Monitor the population size and trends in abundance of the northern right whale.

- 41. Design and implement studies to establish the genetic variation of the northern right whale
- 42. Maintain the northern right whale photo-identification catalog.
- 43. Maintain the northern right whale sighting database.
- 44. Continue a program to monitor annual reproductive success.

45. Design and implement other programs for population monitoring.
46. Identify pre-exploitation population numbers for western North Atlantic stock.
47. Encourage development of new technology useful for population monitoring.

OBJECTIVE 5. Determine and minimize any detrimental effects of directed air and water craft interactions.

51. Adopt regulations on whale watching.
52. Develop and continue a viable research program to investigate and determine the effects of whale watching on northern right whales.
 521. Evaluate the significance of short-term effects of disturbance.
 522. Evaluate the long-term effects of disturbance.
 523. Evaluate the goals and effectiveness of existing whale watching programs.
 524. Establish a program to improve the educational aspects of whale watching.
53. Implement appropriate controls on activities which may result in interactions.
 531. Determine appropriate minimum approach distances to northern right whales.
 532. Determine if multiple platform observations of a whale increases adverse effects.
 533. Determine if certain types of crafts have more adverse effects on whales than do other vessel types.
 534. Determine "optimal" approach geometries, speeds, and operational patterns for approaching whales.
 535. Identify management options, if any, which could reduce effects of whale watching on northern right whales.

OBJECTIVE 6. Coordinate Federal, state, international, and private efforts to implement this recovery effort.

61. Designate an implementation coordinator to facilitate recovery plan implementation.
62. Establish an implementation team (in coordination with other recovery plans if appropriate) with representatives of Federal, state, and private agencies (and international agencies when applicable) to address and respond to lead agency responsibilities.
63. Identify, at an appropriate time, representatives of the above mentioned agencies and the scientific community to review and update this recovery plan periodically.
64. As appropriate, publish regulations to reclassify the northern right whale under the Endangered Species Act.

traditional/historical northern right whale habitat. One northern right whale was killed by a ship in this area in 1986. Shipping frequency needs to be assessed.

1114. Great South Channel.

Northern right whales are present in the area from mid-April through June, although distribution varies from year to year. The Great South Channel is the southern passage to and from the Gulf Of Maine for shipping between Boston, Portland, and points south. Since the shipping lanes are bounded on the east by Georges Bank and on the west by Cape Cod and Nantucket Shoals, it would be difficult to shift them. The frequency of shipping through the channel needs to be assessed.

1115. Southeastern United States (Charleston, South Carolina, to Miami, Florida).

This region is the known primary calving ground for North Atlantic right whales, and is occupied by females before, during and after calving from September through April. Significant shipping ports include Charleston, South Carolina, Savannah and Brunswick, Georgia; and Fernandina Beach, Jacksonville, and Port Canaveral, Florida. There are also military installations with significant ship traffic at Kings Bay, Georgia, and Mayport and Canaveral, Florida. Because of the sand bottom and coastal currents, all of these ports and military installations require extensive maintenance dredging. An assessment of vessel traffic around Kings Bay was done by the Navy for the winters of 1988, 1989, and 1990. Vessel traffic frequency for the rest of the area is unknown.

1116. Migratory routes between the high-use areas discussed above.

Northern right whales move between the high-use areas off New England and Canada to and from the southeastern U.S. waters. The specific routes are poorly known. Northern right whales are vulnerable to ship strikes in these migratory routes but the level of vulnerability is unknown.

112. Analyze known kills and scarring patterns on living northern right whales to identify vessel activities that put whales at risk of collision.

Studies of scars or injuries on whales can provide information about how collisions with ships occurred. Estimates of vessel sizes, types, and travel speeds are needed to identify ships posing a high risk to northern right whales. Such information should be used in conjunction with assessments of vessel types found in each known habitat to identify high risk seasons and regions to target for management actions.

All known ship collision mortalities have involved juveniles less than 4 years old. An assessment of age or sex related behaviors is needed to identify areas and/or seasons where such activities put juvenile northern right whales at risk of ship collisions. Existing data should be examined in more detail to determine how ship strikes may be occurring. Research is needed on the responses of northern right whales engaged in different activities to the approach of large vessels.

12. Reduce ship collisions with northern right whales.

Research and action is needed on nearly every aspect of the ship collision problem. Possible avenues of investigation are listed below.

To be effective, these actions must be coordinated across a broad spectrum of state, Federal, and international governmental agencies, as well as a variety of marine industries. A steering committee composed of representatives from agencies responsible for plan implementation should be formed to coordinate and assist the implementation of this effort.

Vessel traffic in all areas identified in section 111 should be assessed to ascertain the feasibility of the following recommendations.

121. Educate mariners about northern right whales.

Develop educational tools to increase awareness of captains, port authorities, military personnel, dredge operators, and harbor pilots about the endangered status of the northern right whale, its habits and behavior, and how they can help reduce the risk of hitting one.

1211. Publish special warnings of seasonal high-use northern right whale areas.

Publish warnings of seasonal high-use areas and precautionary measures, including recommended vessel speeds in the Coast Guard's and Defense Mapping Agency's Notices to Mariners. Update regularly and transmit information over the Coast Guard's VHF radio Marine Information Broadcasts. Revise annually or more frequently if warranted.

1212. Show seasonal high-use northern right whale areas within shipping lanes on nautical charts.

Integration with other recovery plans will provide protection for all whales, and reduce the danger of collisions for mariners.

1213. Develop and distribute video tapes similar to the one being used by harbor pilots in Savannah and Brunswick, Georgia, where appropriate.

122. Implement appropriate controls on ship operations and design.

Maritime management and regulatory agencies should investigate the feasibility of the following vessel operations, modification, or regulations where and when it is shown they may reduce the possibility of collisions with northern right whales. Such controls should be implemented to reduce the potential liability to mariners under the ESA, as well as reduce the obvious danger to the animals. These or related considerations should be introduced into discussions on the 1982 Law of the Sea Convention when appropriate.

1221. Restrict vessel speed in 'high risk' areas during 'high risk' seasons.

Minimum vessel speeds required for steerage will reduce the chances for collisions by giving the whales more time for evasive action. These restrictions would be seasonal, limited to areas identified under section 311, and in compliance with Rule 6 of the International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS).

1222. Require lookouts on ships that transit 'high risk' areas during 'high risk' seasons.

This would include dredges and military vessels in the Southeast and Cape Cod Bay, in order to spot whales and avoid collisions in those areas as required under Rule 5 of the 72 COLREGS. It may be necessary to restrict vessel activity during times with poor visibility (night, fog, high winds).

1223. Where feasible, customary shipping lanes should be modified around 'high risk' areas during 'high risk' seasons.

Appropriate negotiations should be undertaken, if necessary, to modify customary shipping lanes. This action will reduce the probability of whale/ship collisions at the Browns/Baccaro Banks area and other high risk locations.

1224. If and when feasible, implement placement of acoustical warning devices on vessels.

Any device must effectively alert whales, avoid habituation, and minimize surrounding disturbance. An assessment of such a strategy upon the surrounding acoustic environment and its inhabitants is also needed. Killer whale vocalizations, random noise, pingers, etc., should all be examined for their potential ability to warn northern right whales of the approach of a ship.

1225. Use the best available technology to detect whales in the path of vessels.

Investigate the feasibility of using side-scanning sonar, low light intensity television, infra-red scanners to detect blows, and other technologies to detect northern right whales in the path of an approaching vessel, with the greatest emphasis being given to detection at night or other periods of poor visibility.

1226. Investigate vessel designs to reduce the probability of killing northern right whales.

Modifications to reduce the lethality of collisions, and possibly to improve efficiency, should be pursued. Also investigate how proposed changes in ship and propulsion design might affect the probability of a collision with northern right whales.

1227. Investigate feasibility of using satellite monitored tags for the detection of whales in shipping lanes.

When resolution and transmission response times are improved, satellite data, from transmitters attached to whales, could give real time data which could be relayed to vessels transiting a high-use area during a particular time.

1228. Cooperate internationally to resolve this issue.

Initiate discussions between appropriate United States and Canadian agencies.

123. Vigorously enforce whale-protection laws.

The ESA and MMPA prohibit the take of northern right whales. Provisions of these and other statutes protecting the northern right whale should be vigorously enforced. A component of this effort is increased education of Federal, state, and local law enforcement officials about laws and regulations protecting northern right whales.

13. Reduce or eliminate injury and mortality caused by fisheries and fishing gear.

Entanglement in fishery gear is known to have been responsible for at least three northern right whale deaths during the past 9 years (Table 1). Chafing or scarification, probably caused by entanglement and entrapment in fishing gear such as gillnets, lobster pot lines, seines and fish weirs, has been found on 67 (57 percent) of appropriately photographed animals in the New England Aquarium photo catalog (Kraus, 1990). Northern right whales have also been observed entangled in lines or netting for extensive periods of time. These data indicate that entanglement is a major cause of injury and mortality in northern right whales.

131. Implement appropriate seasonal or geographic regulations for use of certain fishing gear in northern right whale habitats.

Guidelines, restrictions or prohibitions on types or placement of fishery gear should be considered on a regional and temporal basis to minimize or eliminate their impact on northern right whales. Current evidence indicates that gillnets are the predominant fishing gear found in all high-use areas that pose an entanglement threat to northern right whales. Offshore lobster pot fishing gear in the Bay of Fundy could also be a new threat to northern right whales. These fisheries should be restricted during the period when northern right whales are likely to be present.

Current evaluation of potential regional threats, along with suggested initial restrictions, can be summarized as follows and should be updated as necessary.

1311. Bay of Fundy (Canadian jurisdiction).

A bottom gillnet fishery is located inshore of the Grand Manan Basin, but could be a serious problem if the whales moved north as they did in 1972. Fish weirs occur in many locations, and northern right whales have been entrapped in them on several occasions; however, the whales can normally be released without harm. Longlining and otter-trawling occur, but are probably not threats to northern right whales. Drift netting for swordfish is banned in Canada. The lobster season is closed from June 24-Nov. 1, but there may be up to one month of overlap with the presence of northern right whales during November. Inshore lobster pots do not appear to threaten northern right whales significantly, but a new fishery for offshore lobsters, which began in 1988, entangled and drowned one northern right whale in November, 1988. The offshore lobster fishery utilizes up to 25 large traps attached to one surface line. The weight of gear or snagging on bottom obstacles prevents an entangled whale from reaching the surface or swimming. Funds should be made available for jointly funded research projects.

1312. Southern Nova Scotia Shelf (Canadian jurisdiction).

A bottom gillnet fishery based in Shelburne is beginning, but should be restricted when northern right whales are present. Drift netting for swordfish is already banned. Longlining and otter-trawling occur but are not considered threats to northern right whales. The lobster season is closed from June 24-Nov. 1, but there may be up to one month of overlap with the presence of northern right whales during November. Funds should be made available for jointly funded research projects.

1313. Jeffreys Ledge and Maine Coast.

These waters are used by some northern right whales, including young animals, during migration to the Fundy area. Young animals are probably more likely to become entangled in fishery gear, but no reports of mortality are available for this section of coastline. Gillnets for bottom fish are common on Jeffreys Ledge and along some sections of the Maine coast. They could threaten northern right whales from May through September. Bottom trawling is common, but does not appear to threaten northern right whales. Lobster pots are numerous all along the coast. Inshore lobster gear probably does not threaten northern right whales unless many traps are ganged together. Northern right whales are not common enough in these waters to justify gear restrictions at this time.

1314. Cape Cod Bay and Massachusetts Bay.

Gillnets are common and have trapped northern right whales and other whale species. These nets threaten northern right whales from March to May, after which whales and nets may be more scattered. Regulations to restrict the use of gillnets during periods of high northern right whale use of these waters is a high priority. A driftnet fishery from small boats for mackerel occurs in September-November when very few northern right whales are in the area. Boats follow mackerel schools and tend their nets frequently. This fishery does not appear to pose a threat to northern right whales. One new fish weir has been constructed near Provincetown, but the threat that it poses to northern right whales is not yet known.

1315. Great South Channel.

No entanglements have been reported from this region, but the likelihood of reports might be low since it is offshore. Northern right whales are present from April through June. Bottom dragging is the major fishery. The groundfish fishery is closed for haddock spawning during part of the period that northern right whales are present. Gillnetting is most active June through October after northern right whales would usually be out of the region. However, gillnetting occurs throughout the year. Longlines are used to the southern side of Georges Bank. Fishing activity in this area should be assessed to ensure that entanglement is not a problem.

1316. Southeastern United States

A shore-based gillnet fishery poses a threat to northern right whales along the southern coast. These gillnets extend far enough offshore as to be a potential problem for northern right whales, two records of entanglement exist (Valade, pers. comm.). The fishery is regulated by the State of Florida; the effectiveness of the regulatory program in protecting northern right whales is

unknown. Shrimp trawling is the predominant fishery in the southeastern United States, but the boats are slow and noisy, the net mouths small and the gear weak. Surface gillnets are set in the mouths of some rivers, but whales have not been seen as far up the rivers as the nets are set. No new fixed gear fisheries should be initiated in this region during months when northern right whales are likely to be present. A gillnet fishery for tuna, shark, and swordfish has developed in the area and prohibitions on the deployment of nets should be considered in this area during periods when northern right whales are present.

132. Improve procedures for reporting and rescuing northern right whales entangled in fishing gear.

Existing procedures for releasing cetaceans from fishing gear should be investigated and, if necessary, procedures for releasing northern right whales should be developed in consultation with fishermen and other experienced persons. Procedures should minimize injury to the whales and expense to fishermen. Information discussing the need and procedures for prompt reporting of an entangled or entrapped northern right whale should be distributed to coastal newspapers, fishery newspapers and other appropriate media.

These efforts should be coordinated with appropriate parties in the Marine Mammal Stranding Network so that all available resources are utilized and data obtained are made available throughout the stranding network (see Objective 7).

133. Develop or modify fishing gear to reduce the threat of entrapment or entanglement.

Northern right whales frequently swim near gillnets or other fishing gear when it is present in their habitat. Whales may blunder into ropes or nets that they do not detect, or they may be attracted to fishing gear under some circumstances. Therefore, modifications to fishing gear could reduce entanglement/entrapment threats to northern right whales and other large whales (Lien *et al.*, 1990). Modifications (e.g., noisemakers) to increase detection and avoidance; incorporation of weak-links or breakaway links to facilitate escape; development of photo- or bio-degradable materials to promote deterioration of ropes or lines which may become attached to non-target marine life and to promote deterioration of ghost nets; and development of lobster pot warp that sinks if cut are examples that should be investigated.

14. Reduce or eliminate environmental pollution that affects the northern right whale population and its habitat.

Those contaminants known to exist in, or that have the immediate potential of being introduced into northern right whale environment must be identified, their possible effects determined, and their levels monitored. Oil, pesticides, heavy metals, PCBs, plastics or other marine debris, industrial and municipal effluent, and noise are known to seriously impact other species, including cetaceans, pinnipeds, fishes, and zooplankton. The potential individual and synergistic impact of contaminants found in the northern right whale's habitat should be investigated.

141. Evaluate existing data regarding contaminant effects on northern right whales and their prey.

Existing reports have assessed the presence of many contaminants in marine mammals, fishes, and zooplankton, as well as in the environment frequented by

northern right whales. Data on their effects on various marine species are available. These data should be reviewed to assess potential impacts on northern right whales and their habitat. Included in the evaluation should be data on plastics and other marine debris, chemicals and effluent in discharges and runoff, oil and tar balls from oil spills, and other sources such as biotoxins and noise.

142. Design and conduct studies to understand the effects of contaminants on northern right whales and their habitat and establish critical levels.

Studies should address the possible effects of those environmental contaminants identified in 141 as likely to impact northern right whale populations or right whale habitats.

143. Monitor the levels of the contaminants identified in 141 within the northern right whale's environment.

Programs to monitor levels of marine contaminants should be initiated or continued. Complete necropsies and appropriate tissue samples must be taken from all dead northern right whales in order to better understand causes of mortality and factors that may be affecting reproductive success and general health. Laboratory analyses of northern right whale tissue and prey samples should be initiated to determine the presence of suspected pollutants. These efforts may already be underway as parts of other environmental or habitat monitoring programs.

15. Continue international ban on hunting and other directed lethal take.

While hunting of the right whale has been banned by international agreement for over 50 years, there have been, on occasion, some directed lethal takes of northern right whales. The United States government should take the necessary steps to assist in preventing any directed take of the right whale wherever it may occur. These steps should include the harshest economic sanctions, if necessary, to prevent directed take. Therefore, the United States government should not hesitate to impose trade sanctions under the Pelly Amendment, if such sanctions would prevent a directed take.

Objective 2. Maximize efforts to free entangled or stranded northern right whales and acquire scientific information from dead specimens.

Rescue of entangled or stranded right whales that are still alive has the highest priority since each individual represents a substantial portion of existing genetic diversity of the species. Longer term veterinary assistance and rehabilitation of specimens should be attempted if logistically feasible. It is not likely that these opportunities will arise often, but contingency plans must be available for execution at short notice. Released right whales should be equipped with bio-telemetry equipment to follow their progress and provide migrational and other information.

Causes of known northern right whale mortality during the period 1980-1989 (Table 2) include entanglement in fishery gear or other ropes, collision with ships and undetermined causes. These human-related accidents are primary causes of death in at least one-third of northern right whale mortalities during the past decade. Cause of death has not been found in over one-third of these mortalities, but more careful necropsy could lower that fraction. New necropsy techniques can evaluate the possibility that genetic inbreeding in the small remaining population may contribute to death from "natural causes."

The following actions must be taken to identify, categorize and reduce and/or eliminate mortality and injury. The existing salvage and necropsy program for marine mammals must be strengthened to meet the goals of this Plan. The program operates with very little funds and currently cannot support expensive analyses or retrieval of entire carcasses or skeletons. Table 2 indicates that one or two northern right whale mortalities may be found each year, on average. Only 11 complete or nearly-complete skeletons exist in museum collections in the entire United States. Each carcass is therefore extremely valuable to science in general as well as a potential source of information that may be valuable to the recovery effort. All reasonable efforts should be made to secure carcasses and gain all information that they can provide.

21. Improve and maintain the system for reporting stranded or distressed northern right whales.

The existing marine mammal stranding network on the east coast of the United States is marginally adequate to report beached northern right whales. This network is critical and continued support of its operation is a top priority. Greater efforts are needed to solicit reporting by fishermen and ship captains of carcasses afloat offshore. Currently, most reports of floating carcasses are not investigated and even the species of whale involved is generally not determined. There is a need to locate and examine all reported floating carcasses, and if one is identified as a northern right whale, a commitment is needed to tow the carcass to shore for full necropsy and salvage. All stranded or distressed animals must be photographed for individual identification. In eastern Canada a coordinated stranding network is presently being organized (Lien, pers. comm.).

22. Develop an improved program for handling live stranded or distressed northern right whale.

Due to the extremely low numbers of individuals in this stock, each live stranded or distressed northern right whale represents a significant loss to the species' recovery. Therefore, all efforts to disentangle, remove from the beach, or rehabilitate live animals should be made.

221. Develop a centralized system for reporting and rescuing stranded or distressed northern right whales.

The existing NMFS stranding network should include a central clearinghouse, such as The New England Aquarium in Boston, Massachusetts, for all reports of stranded or entangled northern right whales, living or dead. A 24-hour telephone hotline for reporting marine mammal strandings plus veterinary support should be available if necessary. Updated lists of telephone numbers for secondary contacts should be maintained by the stranding network and central clearinghouse and distributed on a regular basis to individuals and Federal, state, local and private/non-profit sector agencies identified with ongoing salvage efforts. Telephone lists or other pertinent information should be distributed as appropriate through existing instruments for communication and coordination (e.g., Smithsonian Institution's Marine Mammal Events Program (MMEP) Quarterly Reports, NMFS Regional Fisheries Centers Quarterly Reports, Entanglement Network Newsletter). Posters and other educational instruments should be designed and distributed to facilitate identification of northern right whales and ensure prompt reporting of any specimens.

222. Identify areas/facilities and transportation/containment systems able to handle rehabilitation of a live northern right whale.

Contingency plans should be made to move a live northern right whale to a protected area capable of holding an animal for long-term rehabilitation if necessary. Facilities capable of supporting such an effort and funding commitments must be arranged in advance to cover the long-term care of a northern right whale before such a large project could be approved. Procedures for towing a live northern right whale safely should be designed in consultation with appropriate organizations that would respond to and support such an activity.

23. Improve the existing program to maximize data collected from dead northern right whales.

The existing salvage and necropsy program for marine mammals must be strengthened to meet the goals of this Plan. Each carcass is therefore extremely valuable to science in general as well as a potential source of information that may be valuable to the recovery effort. All reasonable efforts should be made to secure carcasses and gain all information that they can provide.

231. Establish designated salvage and necropsy sites at strategic locations along the Atlantic Coast.

It is important to identify appropriate locations along the east coast where northern right whale carcasses can be towed and beached for salvage and necropsy. These sites should be selected for their proximity to traditional areas of northern right whale mortality, and for logistical features such as distance from populated areas and accessibility to salvage and necropsy personnel. After consultation with appropriate state, local and scientific authorities, sites should be designated at least in Georgia, on Cape Cod, and in the Bay of Fundy, where future mortalities can be reasonably predicted. Formal designation of these sites will greatly enhance the effectiveness of salvage and necropsy by allowing for contingency planning in the areas of logistics, inter-organizational cooperation and final disposition of carcass material. In the past, much valuable data and specimen material has been lost because of an inability to locate and gain permission to beach a large whale on a site for long enough to finish careful necropsy and salvage. These situations have previously been handled as emergencies where logistics must be worked out within a matter of hours or the opportunity to gather data and specimen material is lost. The greatest concern expressed by land managers is the fear that a carcass will be left permanently on a beach, causing a great public nuisance. Planning must include the commitment to bury or tow out to sea any carcass material remaining after necropsy and salvage. However, a reasonable period of time must be allowed for the necropsy and salvage to be completed before the final cleanup is undertaken. Considering the infrequency of known mortalities of North Atlantic right whales, salvage should at least include genetic information, reproductive tissues, the skull from every animal, the entire skeleton whenever possible and any soft tissue which could provide environmental toxin data.

232. Develop and distribute instructions for securing and retrieving floating carcasses of northern right whales.

Special precautions must be taken to ensure that a floating carcass is not lost between the time that it is reported and the time that scientists arrive on the scene. Reporting vessels should be encouraged to provide exact coordinates and stand by the carcass if possible until arrival of an official vessel. Up-to-the-moment wind

and tide conditions should be provided if the reporting vessel cannot stand by. Attachment of a spar and radar reflector should be done, if possible and appropriate. Authority to tow the carcass should be given to a private vessel if no official vessel is available. Instructions should also be given for taking photographs suitable for individual identification. A summary of methods and precautions for towing carcasses should be prepared in conjunction with the Coast Guard and after consulting whaling literature as appropriate.

233. Perform comprehensive analyses of tissue samples.

Appropriate tissue samples should be taken in accordance with stranding network protocol to assay body load of organic and inorganic contaminants and natural biotoxins; and to investigate the possible role of parasites, microorganisms, physiologic or genetic defects or inbreeding depression of reproduction. Samples should also be taken for age determination, reproductive state, and other demographic information such as genetic relatedness to known animals. These investigations, involving collaboration by many laboratories and scientists, require careful preservation, storage, disposition and archiving of selected samples. A central database of available northern right whale tissues should be created and maintained.

234. Determine causes of mortality and utilize information to reduce susceptibility to death from these causes.

Studies of stranded northern right whales are of such critical importance that trained veterinarians and scientists should often be dispatched to the scene immediately. Travel funds for such purposes need to be provided and need to be available on short notice. Clear instructions for persons on the scene should be prepared, updated as needed and distributed. Protocol for examination and sampling of specimens should be described and updated as needed. The NMFS Handbook on Examination of Marine Mammals (Hare and Mead, 1987) should be distributed to appropriate personnel to demonstrate how photography and external examination can reveal evidence of ship strike or entanglement in ropes or nets. Appropriate tissue samples must be taken to assay body load of organic and inorganic contaminants and natural biotoxins; and to investigate the possible role of parasites, microorganisms, physiologic or genetic defects or inbreeding depression of reproduction. Samples should also be taken for age determination, reproductive state, and other demographic information such as genetic relatedness to known animals. These investigations, involving collaboration by many laboratories and scientists, require careful preservation, storage, disposition and archiving of selected samples. A central database of available northern right whale tissues should be created.

24. Establish or identify funding sources for emergency rescue and rehabilitation efforts.

The current salvage and necropsy program has been kept active by small grants from the private and non-profit sector. Federal contributions have included expertise and cooperation from scientists at the Smithsonian Institution's MMEP and *ad hoc* cooperation of sectors of agencies such as NMFS, U.S. Fish and Wildlife Service, U.S. Coast Guard and others. Explicit directives urging full cooperation in securing or transporting carcasses should be provided to all appropriate Federal agencies and employees. Federal funding should also be dedicated to guaranteeing continued existence of a coordinated salvage/necropsy program.

OBJECTIVE 3. Identify and protect habitats essential to the survival and recovery of the northern right whale.

By virtue of particular biological, physical, and/or chemical conditions, certain geographic areas appear to be essential for meeting the biological requirements of northern right whales. Human activities may either diminish the capacity of these areas to meet these requirements, or act to displace whales to less suitable habitats. For example, oil spills or discharges of toxic chemicals in preferred feeding areas may contaminate or reduce the abundance of prey. Similarly, if pregnant females are displaced from preferred calving areas, other sites may not be suitable for successful calving and nursing. Restoration and maintenance of a population can only succeed if essential habitats are maintained in an optimum condition over an extended period of time because the recovery of the northern right whale will probably not occur in our lifetime.

The marine ecosystem is a complex and dynamic environment. No single component or habitat exists in isolation from the system as a whole. Physical boundaries between regions or ecosystem components are usually variable and migratory species shift from one region or food web to another. As in all ecosystems, impacts on one component of the ecosystem usually affect the other components in some way. Long-term protection of any individual species or habitat must eventually include reduction of adverse anthropogenic impacts on the entire marine ecosystem.

Natural events or environmental conditions, such as changes in weather or climate, or shifts in the prey distribution, may affect the location and condition of essential habitats. Although such changes cannot be predicted at the present time, it is important that the recovery program be flexible to respond when changes are detected.

To date, five essential habitat areas have been identified in the coastal waters of the United States and Canada. Four of these areas are used seasonally as feeding, mating, and/or nursing areas. They are the Great South Channel, Cape Cod and Massachusetts Bays, the lower Bay of Fundy, and the southern Nova Scotian shelf. The fifth area, which is used during winter by females as a calving and nursing ground, includes nearshore waters off Georgia and northeast Florida. Habitats used by other age and sex classes of northern right whales during the winter have not yet been located, and other feeding or calving grounds might exist.

The survival and eventual recovery of the North Atlantic right whale population is dependent upon protective measures both for the species and its habitat. Existing Federal, state, provincial and local laws and regulations must be rigorously enforced in regard to northern right whale habitat. If existing conservation statutes or programs are found to be inadequate to protect northern right whale habitat, then additional statutes should be promulgated as necessary, and programs developed to improve protection of essential habitat.

Under the ESA, special emphasis should be placed on protection of essential northern right whale habitat in Section 7 consultations carried out by all Federal agencies. Other applicable Federal and state statutes should be strictly applied in situations involving known northern right whale habitat.

Existing protective mechanisms may or may not be adequate to detect problems affecting northern right whale habitat. In addition, restrictions put in place to mitigate known adverse effects to essential northern right whale habitats may not be properly carried out due to inadequate follow-up monitoring. An evaluation of the adequacy of existing statutes to protect each known habitat is necessary.

Additional regulations may be required, or additional information, education, and/or enforcement programs under the ESA, or other statutes, may have to be instituted in order to prevent the degradation or destruction of essential habitat.

Coastal state involvement should be encouraged through Cooperative Agreements, as provided for in Section 6 of the Endangered Species Act, to further protect northern right whale habitat. Appropriate budget priority should be given to fund these Agreements.

Specific environmental conditions believed to be important to northern right whales in the five known high-use areas are described below. Potential threats to these habitats are identified.

The following research and management actions are needed to better identify, characterize, and protect essential habitats for northern right whales in the northwest Atlantic Ocean.

31. Protect habitats in U.S. waters already known to be of special importance to the northern right whale.

Even if human-induced northern right whale mortalities can be reduced or eliminated, survival and recovery of the western North Atlantic population will ultimately depend upon the continued availability of suitable habitat for successful feeding and reproduction. Extensive data collected over the past decade or more show that specific areas are consistently utilized by northern right whales within known seasons year after year. Given the continued depleted state of this population, these areas should be considered for protection.

With this concern in mind, the Right Whale Recovery Team has submitted a petition to NMFS requesting that the three known high-use areas in U.S. waters (the Southeast calving area and the Cape Cod Bay and Great South Channel feeding areas) be designated as critical habitat. For information on long-term use of the areas petitioned for critical habitat see Kraus and Kenney (1991).

311. Florida/Georgia calving ground.

This area is where northern right whale calves are first seen. The broad shallow shelf waters provide a relatively undisturbed area protected from major winter storms. Mothers are often found at the surface with their less mobile calves. Accidental collisions with vessels may be their most serious threat. Disturbance of this area should be especially avoided in the winter. OCS oil and gas activities, mineral mining, ocean dumping, dredging, and any additional physical or acoustical disturbances should not be initiated in the winter months. Rapid human population growth currently occurring in the area may increase pressure on this habitat unless any demonstrated and/or proven adverse effects are adequately mitigated.

Area petitioned for consideration as critical habitat:

Coastal waters between 31° 15'N (approximately the mouth of the Altamaha River, Georgia) and 30° 15'N (approximately Jacksonville, Florida) from the coast out to 15 nautical miles offshore; and the coastal waters between 30° 15'N and 28° 00'N (approximately Sebastian Inlet, Florida) from the coast out to 5 nautical miles. (Figure 1)

Northern right whale cow/calf pair sightings have been reported from Cape Hatteras, North Carolina, down into the Gulf of Mexico. The area petitioned for

critical habitat contains 78 percent of all sightings south of Cape Hatteras and 85 percent of all sightings of cows with newborn calves.

312. Great South Channel spring feeding area.

Major concentrations of northern right whales (as well as other endangered large whales) are found in this area in the early spring. They are drawn to this area to feed on the productive blooms of plankton that occur along convergence zones of cold/warm water masses in this area each spring. This area is currently deleted from OCS oil and gas leasing activities and is presently closed to commercial trawl fishermen February through May. These closures, although not directly implemented for northern right whales, should continue.

Area petitioned for consideration as critical habitat: The area bounded by the following coordinates: 41°40'N, 69°45'W; 41°00'N, 69°05'W; 41°38'N, 68°13'W; 42°10'N, 68°31'W. (Figure 2)

313. Cape Cod/Massachusetts Bay late winter feeding/nursery area.

Northern right whales are found in the Cape Cod Bay and Massachusetts Bay area in the late winter to early spring. Cow/calf pairs are often seen. Whales appear to be feeding on large surface blooms of plankton produced in the shallow waters during this period. The effects of coastal pollution from various sources need to be investigated and controlled, if necessary, because of the potentially adverse effects on plankton productivity. Outfall disposal of terrestrial-generated pollutants should be discouraged within these Bays. Ocean dumping in the region may further reduce the productivity of these Bays. Increased vessel traffic in the Bay waters during the winter and early spring could disperse surface plankton concentrations, but no data are available on this topic.

Area petitioned for consideration as critical habitat: The area bounded by the following coordinates: 42°04.8'N, 70°10'W; 42°12'N, 70°15'W; 42°12'N, 70°30'W; 41°46.8'N, 70°30'W; and on the south and east by the interior coastline of Cape Cod. (Figure 3)

32. Promote Canadian action to protect the two known critical areas in Canadian waters.

Although the Recovery Plan for the northern right whale is an initiative of the United States, significant areas of summer distribution are outside U.S. waters. For this reason the cooperation of other nations, especially Canada, is essential for the success of the Plan.

321. Lower Bay of Fundy summer feeding/nursery area.

Cow/calf pairs concentrate in the lower Bay of Fundy region during the summer. This region is relatively clear of the degradation factors seen in other areas. Steps should be taken to discourage their introduction into this area. The effects of proposed tidal power projects throughout the Bay of Fundy on the lower Bay convergence zones used by northern right whales need to be known before the projects are approved.

322. Southern Nova Scotian shelf summer feeding area.

Large numbers of northern right whales concentrate in a relatively small geographical area between Browns and Baccaro Banks. Very few environmental degradation factors affect this region, and steps should be taken to ensure that none are introduced.

The ESA (Section 8) and MMPA (Section 108) encourage the development of agreements with other nations for the protection and conservation of endangered species. For North Atlantic right whales, these should include; (1) Protection of the two high-use areas in Canadian waters--the Bay of Fundy and Browns/Baccaro Banks (up to 70 animals may be present in these waters during the summer months), (2) establish jointly funded research projects to better understand and protect the full needs of the northern right whale throughout its known range, (3) review adequacy of existing international laws, agreements, and related regulations, (4) propose new laws or amendments, as appropriate, to protect the northern right whale and its habitat, and (5) jointly administer and enforce international laws, agreements, and regulations as appropriate.

In early June 1989 specific plans for protection in this area were proposed, but implementation is likely to be some time away, as there are many practical difficulties. The Chairman of the Ministerial Advisory Committee on Whales and Whaling received a letter from the Chairman of the Task Force on this issue and also a specific plan for Canadian sanctuaries from East Coast Ecosystems, Inc. These have been approved or supported by the committee and forwarded to the Department of Fisheries and Oceans for advice and consideration on action. The Minister, therefore, should be cognizant of Canada's special responsibility for two major northern right whale summer feeding habitats, especially the Bay of Fundy area where almost all new calves are concentrated. All species of Cetacea are technically protected from hunting or disturbance in Canadian waters by the Whale Protection Regulations of 1982, which were formulated within the broader context of the Fisheries Act of Canada.

Canada is encouraged to provide protection to the Bay of Fundy, Brown's Bank, and Baccaro's Bank through initial designation of each area as a "Natural Marine Area of Canadian Significance" and possibly a Marine Park.

33. Periodically review the effectiveness of protective measures; update and/or revise as required.

Northern right whale distribution and habitat use may depend heavily on the distributions of their prey, such that any changes in prey distribution will affect northern right whales. If critical habitat is designated, the boundaries must be reviewed periodically to enable alteration of the defined area(s) in response to such changes. The 5-year status review intervals required under the ESA may be sufficient, with the capability for reviews at shorter intervals in response to extraordinary circumstances.

331. Provide a higher level of protection if required for any of these areas.

Designation of critical habitat only provides legal protection of an area from activities conducted or funded by Federal agencies. Some of the areas identified in 31 may be determined to be of such critical importance to the continued survival and recovery of western North Atlantic right whales that increased protection will be necessary. Additional protection may be obtained under the National Marine Sanctuaries Act, National Estuary Program, Magnuson Fisheries Management and Conservation Act, Coastal Zone Management Act, OCS Lands

Act, Canadian Marine Park designation, and related state and provincial statutes if appropriate.

331. Protect other essential areas identified in Section 36.

As essential habitats are defined, their relative environmental health must be determined, potential and known threats identified, and steps taken to minimize their effects.

34. Improve knowledge of how northern right whales utilize their habitats.

Effective habitat protection requires understanding of how northern right whales make use of the habitat. Any changes or updates in the habitat protection programs will require better understanding of habitat use patterns. Furthermore, recognition during the periodic review of any alterations in habitat use patterns which would require such changes or updates necessitates continuous monitoring of habitat use patterns and development and maintenance of long-term data series.

341. Conduct comprehensive studies of northern right whale habitat use patterns and modify habitat protection strategies as appropriate.

Initial studies are underway on various aspects of habitat use in each of the five known high-use habitats. These investigations include such things as activity cycles, feeding and foraging behaviors, diving behavior, small-scale movements, short- and long-term distributional shifts, and relationships to oceanographic parameters. These studies should be conducted through an appropriate time series to provide a complete understanding of habitat use by northern right whales.

3411. Determine differences in habitat use by age, sex, reproductive status, matriline, or individual variation.

Population monitoring programs may indicate that one or more segments of the western North Atlantic right whale population are subject to impacts which are hindering recovery. In such a case, knowledge of habitat use patterns by different population segments becomes critical. Photoidentification and genetic studies, in addition to radio tagging, satellite monitored tagging and behavior studies currently provide data which can elucidate these differences.

3412. Increase knowledge of numbers of animals present and residence times in known habitat areas.

Aerial and shipboard surveys are currently recognized as the best method for providing estimates of absolute and relative population abundance within a specific habitat, as well as the timing of residency within that habitat. Since the northern right whales' use of any specific habitat is highly seasonal, it is likely that certain habitat protection measures will also be seasonally enacted and enforced, requiring clear knowledge of temporal habitat use patterns. An appropriate time series of surveys should be conducted to develop an understanding of abundance and residence in each habitat.

3413. Determine routes and timing of migration between known high-use habitats.

The known northern right whale high-use habitats are widely separated. The timing of movements between the areas are not well known, and the routes taken are almost completely unknown. Adequate survey coverage can assist in determining timing, and radio-tag studies and satellite monitored tags are presently used to determine migration routes. Satellite monitored tags will be most efficient and effective once the technology is refined.

342. Understand the feeding ecology of northern right whales in the western North Atlantic.

Except for the Southeast calving ground, northern right whales primarily use known habitats for feeding. Northern right whales are believed to have very specific and narrow requirements in terms of prey characteristics and distributions. It follows that protection of critical habitats centers around protecting major feeding areas. Therefore, a detailed understanding of feeding ecology is required.

3421. Compile and evaluate existing data on known and potential prey and competitor species.

Aspects of the biology of principal prey species (e.g., distribution, abundance, growth rates, seasonality, etc.) are important components in understanding prey availability. In addition, competition from other predators will also have a strong effect on the availability of that prey to northern right whales. Existing data on the biology of calanoid copepods and of such potential competitors as sei whales, basking sharks, and planktivorous fishes should be compiled and analyzed to better understand the distribution and abundance of northern right whale prey.

3422. Review and refine energetics models to better understand northern right whale food requirements and feeding strategies.

The best known method of estimating the characteristics of prey required by a predator is by modeling the bioenergetics of the predator's food requirements and feeding behavior. The models currently available for the northern right whale and other cetaceans are only crude approximations that result in a wide range of estimated values. Refinement of the models is only possible through detailed field studies to narrow the uncertainty in the input parameters.

3423. Design and conduct studies as required to fill gaps in knowledge of feeding requirements as determined in 3421 and 3422.

Research programs to provide a complete understanding of the specific ecological requirements of northern right whales should be conducted. These studies must address the feeding ecology of the whale at the appropriate range of scales, beginning at the micro-level and expanding to the regional level.

35. Characterize known habitats of special importance to the northern right whale and protect as necessary.

Effective habitat protection for the northern right whale will require a more complete understanding of the specific factors which make any particular habitat area

important. Why do northern right whale mothers go to the coast of Georgia and Florida to calve rather than some other location? Assuming that northern right whales select their feeding grounds on the basis of overall abundance and localized density of prey organisms, what are the oceanographic and meteorological factors which are controlling prey patterns? In addition to protecting known northern right whale habitats, detailed characterization will facilitate effective search for other northern right whale habitats which are currently unknown, and guide restoration of degraded historic habitat. Understanding all of these factors will enhance the recovery of the species.

351. Compile existing physical, chemical, biological, and meteorological data for known high-use habitats.

Characterization of any northern right whale habitat will require analysis of an extremely diverse array of data. Factors which could affect the desirability of a calving area might include water temperature, clarity, depth, bottom type and slope, current speed, wave intensity, presence of predators, presence or absence of disturbance by human activity, frequency of major storm events, and prevailing wind direction and strength. For a feeding ground, they could also include temperature, stratification, mixing regime, tidal currents, recirculation patterns such as current gyres, water chemistry, and phytoplankton productivity. Many of these data will have already been collected for some or all of the habitat areas through past and/or ongoing programs, e.g., MARMAP program, satellite remote-sensing, SCOPEX, and various Federal, state, and university environmental monitoring programs). These data will need to be compiled, then analyzed for similarities and differences between the known habitats.

352. Design and conduct studies as required to accurately characterize these habitats.

36. Identify and protect as necessary other habitat(s) essential to the survival and recovery of the western North Atlantic right whale population.

At least one major habitat of the western North Atlantic right whale population remains completely unknown. During the winter, while a small segment of the population is calving along the southeast U.S. coast, the location of the majority of the population is not known. Recently collected photographic and genetics data suggest additional calving and/or feeding grounds are being used by this population which have not been discovered.

Northern right whale habitats which have been newly discovered by satellite monitored tagging studies or other research, or which have been re-occupied by an expanding northern right whale population, will need to be protected to ensure the continued survival and eventual full recovery of the population. Therefore, protective measures should be instituted following their discovery and demonstration of their status as important to the population.

Newly discovered or re-occupied northern right whale habitats will not all require the same level of protection from impacts. If a single, concentrated wintering area is located where most or all of the wintering, non-calving individuals are found to be mating, then that area would need to be protected as soon as possible. If, on the other hand, mating individuals are found to be dispersed through most of the region and not in any consistently predictable locations, then protection of winter breeding grounds would be less feasible. Temporary or infrequently occupied feeding grounds, occasionally used calving areas, migration corridors, etc., might be amply protected by marking on navigation charts, Notice to Mariners, or similar less restrictive measures.

Discretion at disclosing newly discovered use areas will have to be exercised so as to not adversely affect the northern right whale or its habitat.

361. Locate and protect the still unknown wintering area(s) of the population.

Courtship and mating-like behavior has been observed in all four feeding areas at various times. However, based on the estimated gestation period and known winter calving, it is likely that successful mating occurs during the winter when the location of the mating individuals is not known. However, the possibility of unique periods of receptivity or delayed implantation should not be disregarded. Wherever mating occurs, the location would be a habitat important to the survival and recovery of the population. There is no evidence to suggest whether mating is dispersed over broad areas of the ocean, or occurs within one or more localized areas of aggregation. Satellite monitored tags deployed in the summer or fall would appear to be the most effective method of locating such wintering grounds.

362. Review historical catch and sighting data to identify other possible feeding, calving, or breeding areas.

Northern right whales have been hunted extensively in the western North Atlantic for centuries, and many records of catches exist. Similarly, there are in existence records of sightings of northern right whales during this century. Many of these data have already been compiled, but some sources still need to be investigated. Compilation of all of the available data in a single data set may provide some indication of other likely areas used by northern right whales. It may also suggest areas that might become important northern right whale habitats after population abundance recovers to some higher level or it could indicate which habitats have changed significantly and no longer are capable of supporting northern right whales.

363. Examine existing oceanographic data for likely areas based on the results of habitat characterization studies (35).

The characterization of known northern right whale high-use habitats may suggest the location of other likely habitat areas. Existing oceanographic data should be examined to search for other areas which exhibit similar characteristics to the known habitats.

364. Design and conduct surveys of likely wintering habitats (361) and other areas (362 and 363).

Any new areas found to be utilized by northern right whales in the winter from the satellite monitored tagging studies should be surveyed immediately to delineate the area used, count and identify individuals, and begin to study distribution and habitat use patterns. Similarly, areas which are identified as likely northern right whale habitat based on compilation of catch and sighting records or comparison of habitat characteristics can also be surveyed during the appropriate season to confirm the presence or absence of northern right whales using the area.

OBJECTIVE 4. Monitor the population size and trends in abundance of the northern right whale.

In the long-term, monitoring is an essential part of ensuring the northern right whale's recovery. A program of monitoring will provide managers with essential information about population abundance and evidence of any increase, decrease, or stabilization of the population. Only through long-term, continuing study of these populations will we be able to fully understand the natural history of this critically endangered species--a vital requirement if we are to come up with any successful management or recovery recommendations. These studies should include examination of the genetic variation of northern right whales using both mitochondrial and nuclear DNA.

41. Design and implement studies to establish the genetic variation of the northern right whale.

42. Maintain the northern right whale photoidentification catalog.

The curation and maintenance of the North Atlantic Right Whale Catalog is a crucial component of any effort to monitor the population. The catalog provides continuing data on reproductive rates, mortality rates and causes, movements, demographics, and population size and trends. New technology (i.e. digital imagery storage) should be utilized to facilitate the handling of photographic data. This task should also include the development of population dynamics models based on the photoidentification data, using the most current or any newly developed and appropriate methods of modeling and analysis.

43. Maintain the northern right whale sighting database.

Any meaningful monitoring program must include the continued maintenance of the long-term database which has been established and is currently being archived at the University of Rhode Island. Newly collected information will need to be added to the database on a timely basis. Because this population is so small, significant trends in the population will be detectable only through multi-year time series of data.

44. Continue a program to monitor annual reproductive success.

Given the very low abundance of the population, the 3-year or greater calving interval, and the relative vulnerability of calves and juveniles to various sources of mortality, the calving grounds off the coasts of Florida and Georgia are of critical importance in monitoring the population's reproductive success. There will be a continued need to monitor the habitat itself, as well as to collect identification photographs of as many mothers and calves as possible to monitor annual calf production. The most efficient and cost-effective method will likely be the continuation of the near-shore aerial surveys, using volunteer pilots when possible. Annual monitoring of calf survival in the Bay of Fundy or other congregating areas should also continue.

45. Design and implement other programs for population monitoring.

Researchers should be encouraged to develop alternative methods of monitoring the abundance of the northern right whale population over the long-term. Since the recovery goal is expected to be achieved only after many decades, with monitoring required throughout that period, such monitoring programs should be designed to operate at relatively low annual costs, if possible.

46. Identify pre-exploitation population numbers for the western North Atlantic stock.

Complete a review of all relevant historical information. Establishment of recovery goals for the northern right whale and evaluation of progress toward these goals should be based on pre-exploitation numbers, if possible. However, those numbers need to be refined and further literature research is needed.

47. Encourage development of new technology useful for population monitoring.

Develop satellite monitored tagging methods and other techniques and implement as appropriate.

OBJECTIVE 5. Determine and minimize any detrimental effects of directed air and water craft interactions.

In November 1988, NMFS convened a workshop to deliberate on the effect of whale watching on whales (NMFS, 1988). Although the findings of the workshop were not addressed specifically toward northern right whales, some of the effects should be considered in the management of northern right whales. Information and observations of vessel activity effects on the southern right whale in Argentina can be used to focus studies on whale watching effects in the Atlantic population. Factors which potentially adversely effect northern right whales should be determined, investigated and minimized to the greatest degree possible.

51. Adopt regulations on whale watching.

The Northern Right Whale Recovery Team recommends that until additional data are available and the possible amending of the Marine Mammal Protection Act to allow for the establishment of a permit system for commercial whale watching, regulations should be promulgated for northern right whale watching. These regulations should include:

1. establishing a minimum approach distance for the northern right whale,
2. requiring a vessel to maintain speed and direction should a northern right whale surface within this minimum approach distance, and
3. prohibiting a vessel from approaching a northern right whale or turning in any manner to intercept a whale.

52. Develop and continue a viable research program to investigate and determine the effects of whale watching on northern right whales.

Effects of whale watching should be examined directly from whale watching vessels, when and where possible, and indirectly from independent platforms. These observations should (1) determine short-term behavior changes as indicators of disturbance, (2) quantify the effects of acoustic disturbance, especially the cumulative effects from multiple sources, and the relationship between underwater noise levels and whale response, (3) correlate trends in population parameters (abundance, distribution, density, and production) with exposure to whale watching (or other) vessels, and (4) quantify energy expenditures or time devoted to avoidance of disturbance sources relative to total energy budgets, including prey dispersal, to estimate any energetic costs related to the impact of whale watching activities.

521. Evaluate the significance of short-term effects of disturbance.

No direct studies have been undertaken to investigate the degree of short-term disturbances. Limited experiments should be designed and conducted to address short-term effects such as overt changes in direction of swimming, changes in respiration patterns, changes in dive time/surface time ratio, changes in acoustic behaviors, and presence of certain surface behavior of whales (e.g., trumpet blows or other indicators of agonistic behavior). Ideally, these experiments should be conducted from a platform which potentially does not introduce its own disturbance factor (i.e., an airship).

522. Evaluate the long-term effects of disturbance.

Long-term population monitoring of northern right whales should be undertaken to (1) obtain reliable estimates of population size, mortality, and reproductive characteristics as might be affected by whale watching activities, (2) document and monitor changes in distribution, life-history parameters and abundance trends for local populations affected by whale watching, and (3) design investigations to determine whether habituation, avoidance, displacement, or other behavioral changes that could result from long-term exposure to whale watching occurs.

Long-term investigations should be undertaken to determine whether whale watching activities affect the quality of the habitat. These investigations should (1) identify whether critical areas or environmental processes (e.g., frontal concentrations of copepods in a micro-scale in Cape Cod Bay) are altered by whale watching and (2) obtain long-term time-series data on factors such as ambient sound levels, levels of vessel traffic and type of vessels involved, prey abundance, turbidity, marine debris and other factors relative to whale watching activities.

523. Evaluate the goals and effectiveness of existing whale watching programs.

Sociological studies are needed to evaluate and/or set the goals of whale watching programs, and to improve and evaluate the effectiveness of existing programs. These studies should (1) determine the education and conservation value of whale watching and interpretation programs; identify and evaluate expressed behavior and attitude changes in the whale watching public; evaluate the effectiveness and improve educational programs and materials, (2) quantify economic benefits of whale watching and associated activities, along with benefits of continuing those activities on a long-term basis, and (3) determine the effectiveness of guidelines, regulations, enforcement programs and operations, and evaluate disseminated literature describing all of the above.

524. Establish a program to improve the educational aspects of whale watching.

An education program should be developed with industry, the conservation community, scientists, and management. The program should include articles written for magazines and other media that reach the private boating public. In addition colorful, easy-to-read brochures should be designed and distributed. Results of research investigating whale watching effects should be made available to the public in an easy-to-read format. Dissemination of this information will require continuous support and coordination from all agencies and institutions involved.

53. Implement appropriate controls on activities which may result in interactions.

The November workshop (NMFS, 1988) participants agreed that if all else is equal, decreasing the distance to the sound source (whale watching boat), increasing the number of boats, and variation in the frequency characteristics and amplitude of the sound would increase the intensity of the effect on a whale. More precise studies on disturbance by underwater sound should be completed.

531. Determine appropriate minimum approach distances to northern right whales.

Acoustic effects studies suggest that, due to variations in sounds made by different boats, basin characteristics, and other oceanographic conditions in conjunction with the differences in behavior of individual whales, universal, absolute distance limits cannot realistically be established to uniformly prevent adverse effects. However, it may be useful to establish some minimum distance limits for intentional approaches by vessels until further research on the effects of whale watching can be investigated and/or until the population increases enough so that restrictions may be relaxed. The Commonwealth of Massachusetts prohibits approaches closer than 500 yards without a permit.

532. Determine if multiple platform observations of a whale increases adverse effects.

Conduct research on the effects of multiple vessel operations around a whale as well as the cumulative effects of several vessels observing a single whale sequentially.

533. Determine if certain types of water craft have more adverse effects on whales than do other vessel types.

Field observations of responses in other whale species (i.e., humpback), indicate that certain vessel types may not be appropriate for whale watching in all locations. When determinations are made, this information should be used to mitigate these impacts as soon as possible.

534. Determine "optimal" approach geometries, speeds, and operational patterns for approaching whales.

Present information suggests that "aggressive" or rapid approaches by a vessel, and sudden changes in vessel activity or engine speed appear to elicit the most dramatic responses from whales. Research is needed on the effects of various approach methods on northern right whales.

535. Identify management options, if any, which could reduce effects of whale watching on northern right whales.

Using information determined from objectives 52 and 53, regulations should be established, where needed, to (1) limit sound production in important whale habitats, (2) curtail whale watching activities in breeding or feeding areas and (3) ensure use of "optimal" approach methodologies, vessel types and speeds, etc. In addition, there should be an increased enforcement effort during the whale watching season. Finally, states and other Federal agencies should be directly involved in this effort. Reports of violators from other whale watching vessels and research vessels should be investigated and prosecuted when sufficient evidence is presented. Finally, a directed effort should be made to discourage

whale watching in the Georgia/Florida calving area until the effects of whale watching can be determined.

OBJECTIVE 6. Coordinate Federal, state, international, and private efforts to implement this recovery effort.

61. Designate a implementation coordinator to facilitate recovery plan implementation.

Many of the tasks identified in this recovery plan would best be accomplished by an implementation coordinator who has responsibility for overseeing the implementation of this and other recovery plans. Tasks would include administering and, if appropriate, developing research contracts, involvement in interagency consultations under the ESA, and involvement in developing, evaluating, and implementing protection measures.

62. Establish an implementation team (in coordination with other recovery plans if appropriate) with representatives of Federal, state, and private agencies (and international agencies when applicable) to address and respond to lead agency responsibilities.

Cooperation and support by many Federal, state, local, and private organizations will be needed to implement the objectives of this recovery plan. To help initiate the implementation of this plan an Implementation Committee should be developed. The Committee should include representatives of the referenced agencies including representatives of foreign governments as necessary. The representatives should be the contact on matters related to recovery efforts. The first meeting of the Committee should be held as soon as practicable after the plan is in place.

63. Identify, at an appropriate time, representatives of the above mentioned agencies and the scientific community to periodically review and update this recovery plan.

As the recovery plan is implemented new information will be collected and the priorities of the implementation plan should be revised as necessary. Representatives of involved agencies and the scientific community should be appointed to revise the plan at least every 3 years for the first 15 years of implementation and every five years thereafter.

64. As appropriate publish regulations to reclassify the northern right whale under the Endangered Species Act.

As recovery objectives are achieved, necessary steps should be taken to reclassify the northern right whale as necessary.

IV. NORTH PACIFIC POPULATION

A. Natural History

1. Stocks

At least two discrete stocks have been hypothesized in the North Pacific. Berzin and Rovnin (1966) recognized one western North Pacific stock while Klumov (1962) proposed two discrete stocks in the western North Pacific, one that summered in the Sea of Okhotsk and the other in the western North Pacific east of the Kurile Islands and Kamchatka. Scarff (1986) includes the possibility of a stock in the Gulf of Alaska (Kodiak and Northwest Ground). However, Scarff (1986) believed that there were insufficient data to discriminate stocks at this time.

2. Distribution and habitat use

Similar to the near coastal continental shelf distribution of northern right whales in the North Atlantic, northern right whales in the North Pacific occur over continental shelf areas. In the summer, they may be nomadic, temporarily aggregating in areas with abundant food resources, then moving on to other feeding areas. Whaling records (Maury, 1852; Townsend, 1935) and recent Japanese and Soviet sighting data suggest that North Pacific right whales ranged across the entire North Pacific above 35°N and occasionally occurred as far south as 20°N. Sightings have been reported from as far south as central Baja California in the eastern North Pacific, and the Yellow Sea in the western North Pacific in the winter, and as far north as the sub-Arctic waters of the Bering Sea and Sea of Okhotsk in the summer (Berzin and Doroshenko, 1982).

a. Summer

North Pacific right whales occur in high latitude summer feeding areas and probably migrate to more temperate waters during the winter calving and mating periods. In the Bering Sea, they have been sighted north of the Bering Strait into the Chukchi Sea (Omura *et al.*, 1969), but they apparently avoid ice-covered polar waters. Scarff (1986) suggests that the summer distribution of the North Pacific right whale may have been continuous across the North Pacific south of the Aleutians.

In the eastern North Pacific, right whales historically summered in Alaska waters, mostly between 50° and 60°N from April or May to September, with a peak in sightings in coastal waters in June and July (Maury, 1852; Townsend, 1935; Omura, 1958; Klumov, 1962; Omura *et al.*, 1969). Important historical concentration areas in Alaska appear to have been located in the Gulf of Alaska, especially south of Kodiak Island (Rice and Wolman, 1982), and in the Eastern Aleutian Islands and southern Bering Sea shelf waters (Braham and Rice, 1984). They were particularly abundant in the Gulf of Alaska from 145° to 151°W (Berzin and Rovnin, 1966).

In the western North Pacific, right whales occur off Japan from May to September, near the Kurile and Commander Islands, Kamchatka, and in the Sea of Okhotsk (Omura, 1958; Omura *et al.*, 1969). Whether these whales also enter Alaska waters is uncertain (Braham and Rice, 1984).

b. Winter

There is less information and speculation on the historic and present winter distribution. Since 1850, there have been fewer than 90 reliable records of North Pacific right whales south of 50°N in the eastern North Pacific. Reliable sightings have been made along the coasts of Washington, Oregon and California, and Baja California south to about 27°N, and

near the Hawaiian Islands (Scarff, 1986). There was a confirmed sighting of a North Pacific right whale on May 9, 1990. The sighting was made and recorded on videotape by a whale watch vessel 4-8 miles (6.4-12.8 kilometers) offshore Catalina Island, California (NMFS, Marine Mammal Events Program Report). Coastal whaling records provided no evidence of wintering areas along the North American Pacific coast. On the Asian side, North Pacific right whales have historically wintered south to 20°N, around the Formosa Strait and Ryukyu Islands, and in the Yellow and East China Seas (Tomilin, 1957; Omura, 1986; Nishiwaki, 1967; Braham and Rice, 1984).

c. Migration

Migration patterns of North Pacific right whales are largely unknown (Braham and Rice, 1984). Braham and Rice (1984) suggest that North Pacific right whales found on summering grounds in Alaska waters probably either migrate from the western North Pacific or are from the population that winters in pelagic waters of the east and central North Pacific. Scarff (1986) concluded that the whales which summered in the Gulf of Alaska probably did not winter off the west coast of North America but may have migrated southwest, joining the whales which summered off Kamchatka at an undetermined location in the western North Pacific.

3. Feeding and prey selection

In the North Pacific, right whales feed on zooplanktonic crustaceans, particularly on concentrations of the copepods *Calanus cristatus* and *C. plumchrus* (Omura, 1986; Klumov, 1962; Nemoto, 1963). Other invertebrates reported with lesser frequency from North Pacific right whales include *C. finmarchicus*, *Euphausia pacifica*, and *Metridia* spp. (Omura, 1958; Omura *et al.*, 1969). Important feeding areas were formerly located in the Gulf of Alaska. The Bering Sea shelf is apparently still used as a summer feeding area by some North Pacific right whales (Brueggeman *et al.*, 1983).

4. Competition

Right whales are generally sympatric with sei whales in the eastern North Pacific. Although sei whales are more opportunistic feeders than northern right whales, sei whales show a strong preference for the same copepods in the eastern North Pacific, but not off the California coast. However, many other species also feed on copepods so the population interactions which may affect the North Pacific right whales food supply are probably more complex than a simple competitive model implies (Scarff, 1986).

5. Reproduction

There appear to be no records of newborn or very young calves in the eastern North Pacific; thus the location of the calving grounds for the North Pacific right whales that summer in the Gulf of Alaska remains a mystery. The lack of regular observations suggests that neither the west coast of North America nor the Hawaiian Islands constituted a major calving ground for North Pacific right whales within the past 200 years (Scarff, 1986). North Pacific right whales may winter and calve far offshore in the North Pacific, but pelagic calving would be inconsistent with the records of nearshore calving grounds off the southeastern United States and with the southern right whale. However, offshore calving is believed to occur for balaenopterid whales (Scarff, 1986).

6. Natural mortality

There is speculation that killer whale (*Orcinus orca*) predation may cause mortality in the eastern North Pacific. However, since there are no data on killer whale/northern right whale interactions it is impossible to evaluate the extent of this predation (Scarff, 1986).

7. Abundance and trends

During the 1840's over 11,000 North Pacific right whales were landed by United States whalers (Brownell *et al.*, 1986). This figure does not take into account whales struck and lost. Therefore, it is likely that the pre-exploitation population was higher than 11,000.

The current population size is likewise unknown. Estimates range from a low 100-200 (Braham and Rice, 1984) to a high of 220-500 (Berzin and Yablokov, 1978, in Berzin and Vladimirov, 1981).

B. Human Impacts

1. Vessel interactions

a. Collisions with ships

No ship strikes of northern right whales have been reported from the North Pacific.

b. Disturbance from vessels

It is uncertain whether increased vessel traffic and commercial fishing in Alaska waters are adversely affecting communication and socialization between North Pacific right whales. Since northern right whales use low frequency vocalizations to locate or attract other northern right whales (Kraus, unpublished data), increased noise levels could disrupt these communications.

2. Entrapment and entanglement in fishing gear

Extensive drift gillnet fisheries occur in the North Pacific. A dead North Pacific right whale was retrieved from a gillnet in Soviet waters on June 21, 1983. The type of gillnet and circumstances under which the entanglement occurred are unknown.

3. Habitat degradation

Increases in noise levels accompany offshore oil and gas activities, and could disturb whales near exploratory operations. Suspension of drilling or seismic exploration activities was required in earlier leases in the Bering Sea if North Pacific right whales were encountered, but no sightings were reported by industry observers.

Offshore oil and gas leasing has occurred in the eastern North Pacific segment of the right whale's range. No discoveries have been announced and most leased areas have proven to be barren of oil. Although no oil spills have resulted from exploratory offshore drilling in these areas, northern right whales might be vulnerable if they were involved in skim feeding behavior. Offshore oil and gas exploration is continuing and additional lease sales are planned for the future.

4. Hunting

Exploitation of this population began in Japan in the 1570's (Omura, 1986) and continued into the early 1900's. The International Whaling Commission estimates that 15,451 North Pacific right whales were taken in the western North Pacific between 1840 and 1909 (Brownell *et al.*, 1986). Stocks were severely depleted by Yankee whalers between 1835 and the early 1850's. Townsend's (1935) records show that about 45 percent of the American harvest between 1840 and 1906 came from the "Kodiak Grounds", the general area from

the eastern Aleutians through the Gulf of Alaska. In the peak years, between 1846 and 1851, an estimated 300 to 400 whaling vessels were taking North Pacific right whales in these waters (Gilmore, 1978). During the period of 1845 to 1849, an estimated 8,044 right whales were taken and an additional 2,100 struck but lost in the North Pacific (Scarff, 1986). By the end of the 19th century, right whales were considered rare in the North Pacific, at least south of Alaska (Townsend, 1886). Further discussion on whaling in the Pacific Northwest can be found in Webb (1988).

North Pacific right whales were killed in this century by modernized whaling fleets before they targeted other whale species. At least 123 additional right whales were taken in the North Pacific between 1910 and 1930 (Scarff, 1986). Between 1905 and 1937, only 24 North Pacific right whale kills are recorded for Alaska and British Columbia waters (Rice, 1974; Brueggeman *et al.*, 1984).

Right whales have been protected from commercial whaling in the Pacific since 1946, but between 1931 and 1982 at least 54 additional Western North Pacific right whales were taken intentionally, 23 were taken for scientific purposes (ten by Soviet researchers and 13 by Japanese researchers), and one was taken accidentally by whalers (Scarff, 1986).

C. Recovery Actions

1. Conservation efforts

Legislation providing protection to the North Pacific right whale is described in section II.C.

The coastal waters of western North America provide only a small portion of the habitat for North Pacific right whale, therefore international cooperation is imperative to recovery.

Little is known about the North Pacific population of the northern right whale. Estimation of numbers of animals, either of the present population or of pre-exploitation levels, are not much better than speculation at this time. Because there may be as few as 100 right whales in the North Pacific recovery may be even slower than in the Atlantic. Until more accurate numbers are available, the assumption is made that the optimum sustainable population for the North Pacific is the same as that for the Western North Atlantic.

2. Recommended actions

The Recovery Team has been unable to identify any area in the North Pacific Ocean where northern right whales occur with such regularity and in such numbers as to justify, at the present time, a major research effort. However, the Team does recommend that every effort be made to try to secure as much information as possible about any northern right whale that should be sighted in the Pacific.

To aid in the identification of an area of abundance for right whales in the North Pacific additional effort and resources should be added to existing research programs for other marine species. When such an area is identified the following recovery actions could be taken. Objective 1 is recommended to begin the task of determining the population size of the northern right whale in the North Pacific. Objectives 2 - 7 could be implemented until a Recovery Plan for the North Pacific Right Whale is developed.

1. Step-down Outline

OBJECTIVE 1. Initiate studies to determine the population size and monitor trends in abundance of the North Pacific right whale.

11. Design and conduct studies to determine the population size of the North Pacific right whale.
12. Design and implement studies which can be conducted in coordination with existing research programs.
13. Establish and maintain a North Pacific right whale photoidentification catalog.
14. Maintain a North Pacific right whale sighting database.
15. Design and implement other programs for population monitoring.
16. Identify pre-exploitation population numbers for the North Pacific right whale.

OBJECTIVE 2. Identify and protect habitats essential to the survival and recovery of the North Pacific right whale.

21. Identify and protect as necessary habitat(s) essential to the survival and recovery of the North Pacific right whale.
22. These habitats should be characterized so similar areas can be searched for North Pacific right whales and be protected as necessary.
23. Review historical catch and sighting data to identify other possible feeding, calving, or breeding areas.
24. Identify migratory routes between the summer and wintering areas.

OBJECTIVE 3. Collect and analyze information on the areas and seasons where potential conflicts exist between vessel traffic and North Pacific right whales, and the types of vessels involved.

31. Educate mariners about North Pacific right whales.
32. Develop and distribute video tapes, similar to the one being used by harbor pilots in Savannah and Brunswick, Georgia, where appropriate.
33. Cooperate internationally to resolve this issue.

OBJECTIVE 4. Vigorously enforce whale-protection laws.

OBJECTIVE 5. Continue international ban on hunting and other directed lethal take.

OBJECTIVE 6. Reduce or eliminate injury and mortality caused by fisheries and fishing gear.

61. When North Pacific right whales are sighted an effort should be made to document indications of fishing gear interactions. If appropriate, seasonal or geographic regulations for use of certain fishing gear in North Pacific right whale habitats should be implemented.

62. Modify or develop fishing gear to reduce the threat of entrapment or entanglement.

OBJECTIVE 7. Maximize efforts to acquire scientific information from dead or stranded North Pacific right whales.

71. Establish and maintain a system for reporting stranded or distressed North Pacific right whales.

72. Establish and maintain a program to maximize data collected from dead North Pacific right whales by performing comprehensive analyses of tissue samples.

2. Narrative

OBJECTIVE 1. Initiate studies to determine the population size and monitor trends in abundance of the North Pacific right whale.

Only through long-term, continuing study of the North Pacific population(s) will we be able to fully understand its natural history--a vital requirement to the successful management and recovery of the species.

11. Design and conduct studies to determine the population size of the North Pacific right whale.

Appropriate studies should be conducted to determine the population size of the North Pacific right whale.

12. Design and implement studies which can be conducted in coordination with existing research programs.

These studies should, to the extent possible, be carried out in conjunction with other marine research programs.

13. Establish and maintain a North Pacific right whale photoidentification catalog.

A photoidentification catalog of the North Pacific right whale should be established and maintained. The catalog should eventually provide the same level of information contained in the North Atlantic Right Whale Catalog.

14. Maintain a North Pacific right whale sighting database.

Any meaningful monitoring program must include the continued maintenance of a long-term database. Newly collected information will need to be added to the database on a timely basis. Because this population is so small, significant trends in the population will be detectable only through multi-year time series of data.

15. Design and implement other programs for population monitoring.

Researchers should be encouraged to develop alternative methods of monitoring the abundance of the North Pacific right whale population over the long-term. Since recovery is expected to be achieved only after many decades, monitoring programs could be possible at relatively low annual costs.

16. Identify pre-exploitation population numbers for the North Pacific right whale.

Complete a review of all relevant historical information. Establishment of recovery levels for the North Pacific right whale could be based on pre-exploitation numbers, which have yet to be accurately determined. Compilation and analysis of all available data in a single data set may provide some indication of other likely areas used by North Pacific right whales. This analysis would include historical whaling records and 19th and 20th century logbooks.

OBJECTIVE 2. Identify and protect habitats essential to the survival and recovery of the North Pacific right whale.

By virtue of particular biological, physical, and/or chemical conditions, certain geographic areas are probably essential for meeting the biological requirements of North Pacific right whales. Long-term protection of any individual species or habitat must eventually include reduction of adverse anthropogenic impacts on the entire marine ecosystem.

Natural events or environmental conditions, such as changes in weather or climate, or shifts in the prey distribution, may affect the location and condition of essential habitats. It is important that the recovery program be flexible to respond when changes are detected.

If existing conservation statutes or programs are found to be inadequate to protect North Pacific right whale habitat, then additional statutes should be promulgated as necessary, and programs developed to improve protection of essential habitat.

21. Identify and protect as necessary habitat(s) essential to the survival and recovery of the North Pacific right whale.

North Pacific right whale habitats which have been newly discovered by satellite monitored tagging studies or other research will need to be protected to insure the continued survival and eventual full recovery of the population.

22. These habitats should be characterized so similar areas can be searched for North Pacific right whales and be protected as necessary.

This could be accomplished by compiling physical, chemical, biological, and meteorological data for habitats as they are discovered, in addition to, designing and conducting studies as required to more accurately characterize these habitats.

23. Review historical catch and sighting data to identify other possible feeding, calving, or breeding areas.

This task should be conducted in conjunction with objective 16.

24. Identify migratory routes between the summer and wintering areas.

If appropriate, information developed under objective 3 should be used to help protect these areas.

OBJECTIVE 3. Collect and analyze information on the areas and seasons where potential conflicts exist between vessel traffic and North Pacific right whales, and identify the types of vessels involved.

If it is found that North Pacific right whales tend to occur in restricted areas for well-defined periods of time, identifying the level and type of shipping activity within those areas during the high-use season will help define potential problems. If collisions appear to be a problem, information learned under Objective 1 for the North Atlantic right whale should be used to reduce or eliminate injury or mortality caused by ship collisions.

31. Educate mariners about North Pacific right whales.

Develop educational tools to increase awareness of captains, military personnel, and other appropriate parties about the endangered status of the North Pacific right whale, its habits and behavior, and how they can help reduce the risk of interactions.

32. Develop and distribute video tapes, similar to the one being used by harbor pilots in Savannah and Brunswick, Georgia, where appropriate.

33. Cooperate internationally to resolve this issue.

Initiate discussions between appropriate United States and Canadian agencies.

OBJECTIVE 4. Vigorously enforce whale-protection laws.

The ESA and MMPA prohibit the take of North Pacific right whales. Provisions of these and other statutes protecting the North Pacific right whale should be vigorously enforced. Increased education of Federal, state, and local law enforcement officials about laws and regulations protecting North Pacific right whales will be helpful in this task and materials prepared for Objective 3 should be employed.

OBJECTIVE 5. Continue international ban on hunting and other directed lethal take.

While hunting of the right whale has been banned by the international agreement for over 50 years, there have been, on occasion, some directed lethal takes of North Pacific right whales. For example, 23 North Pacific right whales were taken for scientific research purposes between 1955 and 1968. Ten were taken by Soviet researchers and 13 by Japanese researchers (Scarff, 1986). The United States government should take the necessary steps to prevent any directed take of the right whale anywhere in the world. These steps should include the harshest economic sanctions if necessary to prevent directed take. Therefore, the United States government should not hesitate to impose trade sanctions under the Pelly Amendment, if such sanctions would prevent a directed take.

OBJECTIVE 6. Reduce or eliminate injury and mortality caused by fisheries and fishing gear.

As noted previously one North Pacific right whale is known to have died from entanglement in fishery gear. Entanglement in fishery gear is known to have been responsible for at least three North Atlantic right whale deaths during the past 9 years. Chafing or scarification, probably caused by entanglement and entrapment in fishing gear such as gillnets, lobster pot lines, seines and fish weirs, has also been documented. Therefore, it is prudent to suppose that entanglement could impact right whales in the North Pacific and to take appropriate actions as further information becomes available.

61. When North Pacific right whales are sighted an effort should be made to document indications of fishing gear interactions. If appropriate, seasonal or geographic regulations for use of certain fishing gear in North Pacific right whale habitats should be implemented.

62. Modify or develop fishing gear to reduce the threat of entrapment or entanglement.

Information obtained under Objective 22 for the North Atlantic right whale should be used in the Pacific if warranted.

OBJECTIVE 7. Maximize efforts to acquire scientific information from dead or stranded North Pacific right whales.

71. Establish and maintain a system for reporting stranded or distressed North Pacific right whales.

There is a need to locate and examine all reported floating carcasses, and if one is identified as a North Pacific right whale, a commitment is needed to tow the carcass to shore for full necropsy and salvage. Greater efforts are needed to solicit reporting by fishermen and ship captains of carcasses afloat offshore. All stranded or distressed animals must be photographed for individual identification.

72. Establish and maintain a program to maximize data collected from dead North Pacific right whales by performing comprehensive analyses of tissue samples.

The existing salvage and necropsy program for marine mammals must be strengthened to meet the goals of this section of the plan. Each carcass is extremely valuable to science in general as well as a potential source of information that would be valuable in any recovery effort. All reasonable efforts should be made to secure carcasses and gain all information they can provide. Appropriate tissue samples should be taken in accordance with stranding network protocol to assay body load of organic and inorganic contaminants and natural biotoxins; and to investigate the possible role of parasites, microorganisms, physiologic or genetic defects or inbreeding depression of reproduction. Samples should also be taken for age determination, reproductive state, and other demographic information such as genetic relatedness to known animals. These investigations, involving collaboration by many laboratories and scientists, require careful preservation, storage, disposition and archiving of selected samples. A central database of available North Pacific right whale tissues should be created and maintained.

TABLES
AND
FIGURES

TABLE 1

Incidental Catch of Western North Atlantic Right Whales in Fishing Gear

<u>Date</u>	<u>Location</u>	<u>Gear Type</u>	<u>Fate</u>	<u>Comments</u>	<u>Source</u>
1987-1989	Nova Scotian Shelf	?	Swimming	Line in mouth ID#1411	Kraus, 1990
1981-1989	Gulf of Maine	Gillnet	Swimming	ID# 1152	Kraus, 1990
1988	Nova Scotian Shelf	?	Swimming	Line in mouth ID# 1113	Kraus, 1990
11/17/88	Bay of Fundy Canada	Lobster Pot	Dead		New England Aquarium
09/86-04/88	Cape Cod Bay Massachusetts	?	Swimming	Line in mouth	Kraus, 1990
02/05/85	Boothbay Maine	Lobster pot lines	Released	Lines around tail	New England Aquarium
09/06/84	Bay of Fundy Canada	Gillnet	?	Swimming with net over head	New England Aquarium
07/26/84	St. Stephens Newfoundland	Cod trap	Believed dead	Escaped with complete trap wrapped around it	Memorial University
05/15/83	Plymouth Massachusetts	Gillnet	Freed itself	Net over head and back. ID# 1306	Center for Coastal Studies
04/05/83	Wrightville Beach, NC	Gillnet	Released	10 feet of net remained on animal	NMNH
02/15/83	100km south of Rhode Island	Otter trawl	Dead	Calf	Kraus, 1990
03/03/82	Jupiter Florida	Gillnet	Released		New England Aquarium
06/16/78	Dennis Massachusetts	Gillnet	Freed itself		New England Aquarium
07/01/76	Long Branch New Jersey	Lobster gear	Released by divers		Reeves <i>et al.</i> (1978)
08/25/76	Wellfleet Massachusetts	Netting & lines	?	Entangled swimming	New England Aquarium
08/02/76	Grand Manan New Brunswick	Weir	Released	Cow/calf pair ID# 1005/1076	Reeves <i>et al.</i> (1978)
01/27/70	Neptune Beach Florida	?	?	Thought to be cow related to stranded calf	FL Times Union 1/27/70 Marineland Records

TABLE 2

Documented Northern Right Whale Mortality in the North Atlantic: 1970-1991

DATE	LOCATION	LENGTH(cm)	CAUSE OF DEATH	SEX	COMMENTS
01/26/70	Florida	439	Unknown	F	Calf
Fall /71	New York	1200(E)	Unknown	?	
01/30/72	Texas	600(E)	Tail Severed*	?	Calf
01/12/74	South Carolina	407	Stillborn(?)	?	Calf
05/11/75	Monomay Is., MA	1030	Unknown	M	Juvenile
04/15/76	Wellfleet, MA	760	Large Bruise	M	6 month Calf
11/05/76	Portland, MN	1100(E)	Cuts in Back	?	Floating
03/05/79	Easthampton, NY	1100(E)	Tail Severed*	?	Juvenile
12/10/79	Atlantic Beach, FL	1550	Unknown	F	
12/30/81	L. St. Simon Is., GA	464	Stillborn(?)	M	Calf
02/20/82	Ossabow, GA	457	Stillborn(?)	F	Calf
04/19/82	38°58.5':69°17.2	900(E)	Unknown	F	Juvenile
02/15/83	Rhode Island	600(E)	Entanglement	?	Calf
02/21/83	Is. Beach St. Pk., NJ	1100(E)	Tail Severed*	M	ID# 1128
07/26/84	Newfoundland	1250(E)	Entanglement ¹	M	J. Lien
07/09/86	Provincetown, MA	1090	Unknown	F	Decomposed
08/07/86	Massachusetts	1100	Spine Severed*	F	ID# 1504
05/22/87	Massachusetts	1200(E)	Unknown	M	Floating
06/12/87	Massachusetts	Photographs indicate same as above but further offshore			
07/11/87	Nova Scotia	800(E)	Propeller Slashes*	M	
00/10/87	Newfoundland	1350(E)	Unknown	?	>6 months dead
01/17/88	Indian River, FL	438	Unknown	M	Decomposed
11/17/88	Bay of Fundy	800(E)	Entanglement	?	Decomposed
01/03/89	Cumberland Is., GA	425	Unknown	M	Detailed necropsy
01/26/89	Ormond Beach, FL	488	Unknown	?	Decomposed
09/08/89	St. Augustine, FL	1200(E)	Unknown	F	ID# 1219
09/08/89	Crescent Beach, FL	400(E)	Unknown	?	Calf/Fetus
03/12/91	Fernandina Beach, FL	1005	Broken skull*	F	Decomposed ID# 1907

* - Ship Kills

(E) - Estimated Length

1 - Decomposed when found in net, may have already been dead when entanglement occurred.

SUMMARY: 27 Documented mortalities -

10 calves (37% of total),

6 ship kills (22% of total),

3 entanglement mortalities (11% of total)

TABLE 3

Unpublished list of Pacific northern right whale sightings north of 50° N contained in the Platforms of Opportunity Program data base, NMFS National Marine Mammal Laboratory, Seattle, WA. Numbers contained in parentheses are tentative sightings. Current listings taken June 10, 1987.

Date	Latitude	Longitude	Number of Individuals	Comments
07/07/77	56°27.5'N	135°38.4'W	1	
03/27/79	59°35.8'N	139°55.8'W	4	Seen at 25 yards
10/16/80	58°48.1'N	145°00.3'W	(1)	
06/21/83	51°29.0'N	173°38.5'E	1	Gillnet Retrieval
09/01/85	54°29.5'N	133°45.0'W	(1)	
09/08/85	56°54.1'N	163°55.6'W	1	

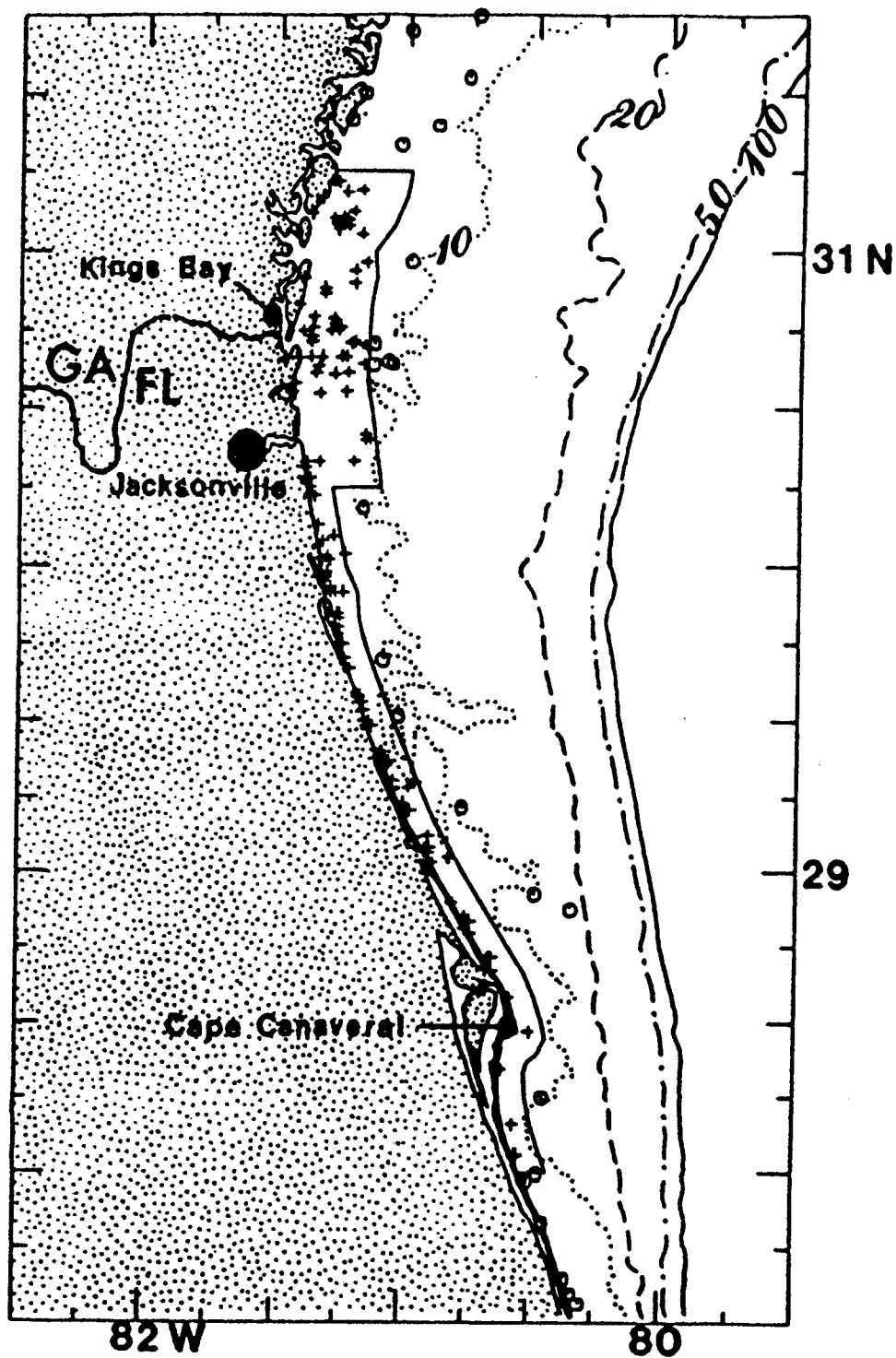


Figure 1. All right whale sightings in and near the proposed southeastern United States critical habitat between 1950 and 1989. Sightings within the proposed critical habitat are shown by '+'; sightings outside by 'o'. Bathymetry shown is in fathoms; N=303 sightings. The proposed critical habitat is defined in terms of distance from shore.

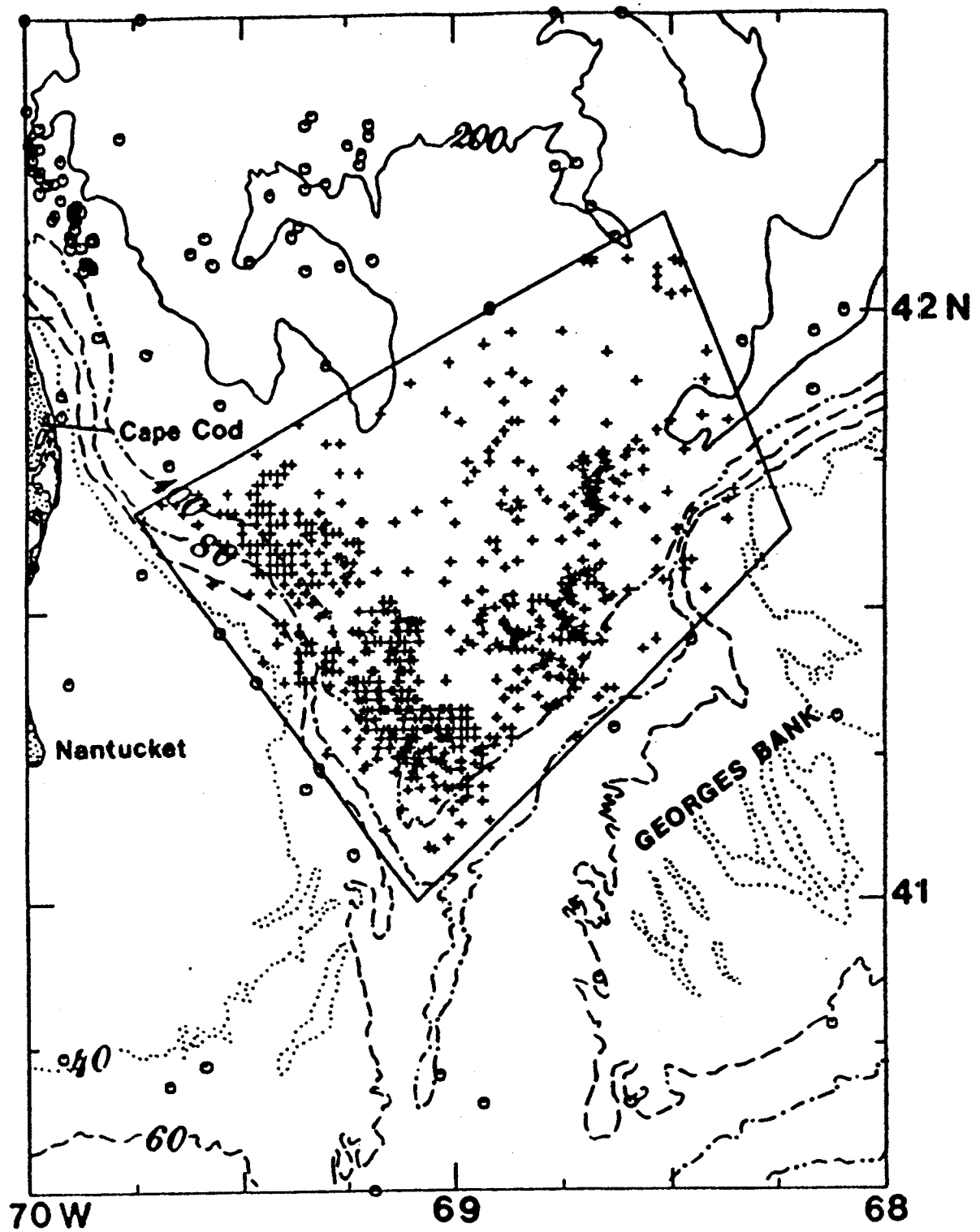


Figure 2. All right whale sightings in and near the proposed Great South Channel critical habitat between 1975 and 1989. Sightings within the proposed critical habitat are shown by '+'; sightings outside by 'o'. Bathymetry shown is in meters; N=942 sightings.

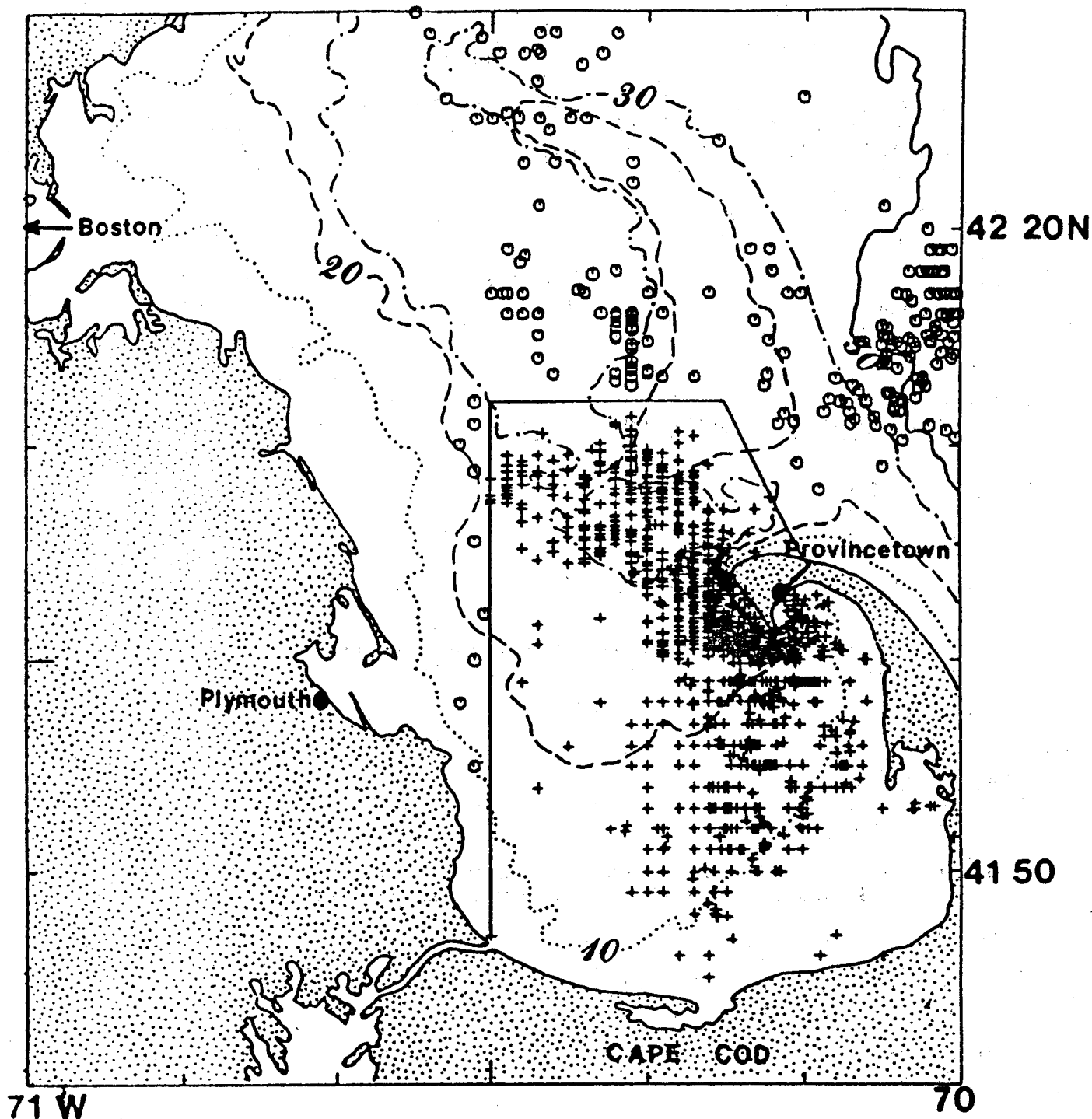


Figure 3. All right whale sightings in and near the proposed Cape Cod Bay critical habitat between 1964 and 1988. Most sightings north and northeast of the proposed boundary are from 1986 and 1987 and considered atypical. Sightings within the proposed critical habitat are shown by '+'; sightings outside by 'o'. Bathymetry shown is in fathoms: N=1665 sightings.

REFERENCES

- Aguilar, A. 1986. A review of old Basque whaling and its effect on the right whales (*Eubalaena glacialis*) of the North Atlantic. pp. 191-200. *In*: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 289 pp.
- Allen, G.M. 1916. The whalebone whales of New England. Mem. Boston Soc. Nat. Hist. 8(2): 107-322.
- Bannister, J.L. 1990. Southern right whales off Western Australia. pp. 279-288. *In*: Hammond, P.S., S.A. Mizroch, and G.P. Donovan (Eds). 1990. Individual Recognition of Cetaceans: Use of photo-identification and other techniques to estimate population parameters. Rpts of the IWC; Special Issue No. 12. Cambridge, England. 440 pp.
- Barkham, S.H. 1977. Guipuzcoan shipping in 1571 with particular reference to the decline of the transatlantic fishing industry. Desert Research Institute, Publs. in the Social Sciences. No. 13: 73-81. Univ. of Nevada, Reno.
- Basta, D.J., B.T. Bower, C.N. Ehler, F.D. Arnold, B.P. Chambers, and D.R. Farrow. In Press. The National Coastal Pollutant Discharge Inventory. *In*: Coastal Zone 85, Proceedings of the Fourth Symposium on Coastal and Ocean Management, Baltimore, Maryland.
- Beamish, P. 1981. Rare sighting of a right whale (*Eubalaena glacialis*). J. Ceta-Research (2): 2.
- Berzin, A.A. and N.V. Doroshenko. 1982. Distribution and abundance of right whales in the North Pacific. Rep. Int. Whal. Comm. 32:381-383.
- Berzin, A.A. and A.A. Rovnin. 1966. The distribution and migrations of whales in the northeastern part of the Pacific, Chukchi and Bering Seas. Izvestia TINRO 58:179-207.
- Berzin, A.A. and V.L. Vladmirov. 1981. Changes in abundance of whalebone whales in the Pacific and Antarctic since the cessation of their exploitation. Rep. Int. Whal. Comm. 31:495-498.
- Berzin, A.A. and A.V. Yablokov. 1978. Abundance and population structure of important exploited cetacean species of the world ocean. Zool. Zh. 7(12):1771-1785. (In Russian)
- Best, P.B. and L.G. Underhill. 1990. pp. 183-190. *In*: Hammond, P.S., S.A. Mizroch, and G.P. Donovan (Eds). 1990. Individual Recognition of Cetaceans: Use of photo-identification and other techniques to estimate population parameters. Rpts of the IWC; Special Issue No. 12. Cambridge, England. 440 pp.
- Braham, H.W. 1984. The status of endangered whales: an overview. Mar. Fish. Rev. 46(4):2-6.
- Braham, H.W. and D.W. Rice. 1984. The right whale, *Balaena glacialis*. Mar. Fish. Rev. 46(4):38-44.
- Brown, S.G. 1986. Twentieth-century records of right whales (*Eubalaena glacialis*) in the northeast Atlantic Ocean. pp. 121-128. *In*: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.

- Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Brueggeman, J.J., R.A. Grotefendt, and A.W. Erickson. 1983. Endangered whale surveys of the Navarin Basin, Alaska. U.S. Dept. Commer., NOAA, OCSEAP Final Rep. 42(1986):1-146.
- Brueggeman, J.J., T. Newby, and R.A. Grotefendt. 1984. Catch records of sixteen North Pacific right whales between 1912 and 1937. Unpubl. Rep. EnviroSphere Company, Bellevue, WA. 16 pp.
- CeTAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Final Report of the Cetacean and Turtle Assessment Program to the U.S. Dept. of Interior under Contract AA551-CT8-48. U.S. Dep. Int., Wash., DC, 450 pp.
- Champ, M.A., T.P. O'Connor, and P. Park. 1981. Ocean dumping of municipal and industrial wastes in the United States: An analysis of environmental effects. Oceans 81: conference record, vol. II, pp. 720. Mar. Tech. Soc., 1730 M St., N.W., Rm. 412, Washington, DC 20036.
- Collet, R. 1909. A few notes on the whale *Balaena glacialis* and its capture in recent years in the North Atlantic by Norwegian whalers. Proc. Zool. Soc. Lond., 7: 91-97.
- Desmoulins, A. 1822. *Balaena australis*. Dict. Class. Hist. Nat., 2:161.
- Fowler, C.W. 1984. Density Dependence in Cetacean Populations. In: W.F. Perrin, R.L. Brownell, Jr. And D.P. DeMaster (Eds). Reproduction in Whales, Dolphins and Porpoises, Rpts. of the IWC Special Issue No. 6, Cambridge, England.
- Fowler, C.W. and T.A. Smith (Eds). 1981. Dynamics of Large Mammal Populations. J. Wiley & Sons, NY, NY. 477 pp.
- Gaskin, D.E. 1987. Updated status of the Right Whale, *Eubalaena glacialis*, in Canada. Canadian Field-Naturalist 101(2):295-309.
- Gilmore, R.M. 1978. Right whale. pp. 62-69 In: D. Haley (ed.), Marine mammals of eastern North Pacific and Arctic waters. Pacific Search Press, Seattle, WA.
- Gray, J.E. 1864., Note on the bonnet of the right whale. Proc. Zool. Soc. Lond. No. 11: 170-171.
- Hare, M.P. and J.G. Mead. 1987. Handbook for Determination of Adverse Human-Marine mammal Interaction from Necropsies. NWAFC Processed Report 87-06: 35 pp.
- Klumov, S.K. 1962. The right whales in the Pacific Ocean. In: P.I. Usachev (ed.). Biological Marine Studies. Trudy Inst. Okeanogr. 58: 202-297.
- Knowlton, A.R. and S. Kraus. 1989. Calving intervals, rates, and success in North Atlantic Right Whales. Unpubl. report to the 8th Biennial Conference on the Biology of Marine Mammals.
- Kenney, R.D., M.A.M. Hyman, R.E. Owen, G.P. Scott, and H.E. Winn. 1986. Estimation of prey densities required by western North Atlantic right whales. Mar. Mam. Sci. 2(1):1-13.

- Kraus, S.D. 1985. A review of the status of the right whale (*Eubalaena glacialis*) in the western North Atlantic, with a summary of research and management needs. NTIS No. PB86-154143, 61 pp.
- Kraus, S.D. 1990. Rates and potential causes of mortality in North Atlantic right whales. *Mar. Mam. Sci.* 6(4):278-291
- Kraus, S.D. and R.D. Kenney. 1991. Information on right whales (*Eubalaena glacialis*) in three proposed critical habitats in U.S. waters of the western North Atlantic Ocean. NTIS No. PB91-194431, 65 pp.
- Kraus, S.D. and J.H. Prescott. 1981. Distribution, abundance and notes on the large cetaceans of the Bay of Fundy: summer and fall 1980. Rep. to U.S. Dept. of Comm., Nat. Mar. Fish. Serv., in fulfillment of Contract NA-80-FA-1-00048.
- Kraus, S.D. and J.H. Prescott. 1982. The North Atlantic right whale, (*Eubalaena glacialis*) in the Bay of Fundy, 1981, with notes on distribution, abundance, biology and behavior. Rep. to U.S. Dept. of Comm., Nat. Mar. Fish. Serv., in fulfillment of contract NA-81-FA-C-00030.
- Kraus, S.D., M.J. Crone, A.R. Knowlton. 1988. The North Atlantic Right Whale, 684-698. In: Chandler, W.J. (Ed). Audubon Wildlife Report 1988/1989. Academic Press, NY, NY. 817 pp.
- Kraus, S.D., J.H. Prescott and G.S. Stone. 1983. Right whales in the northern Gulf of Maine. *Whalewatcher* 17 (4): 18-21.
- Kraus, S.D., J.H. Prescott and G.S. Stone. 1984. Right whales (*Eubalaena glacialis*) in the western North Atlantic: A summary of research conducted from 1980 to 1984. Rept. to the Marine Mammal Commission under Contract MMC-442 and WWF-U.S. under Contract 3154.
- Kraus, S.D., J.H. Prescott and G.S. Stone. 1985. Right whales (*Eubalaena glacialis*) in the western North Atlantic: Research Progress from June 1984 to April 1985. Final Rept. for 1985 to World Wildlife Fund-U.S. under Contract 3154.
- Kraus, S.D., J.H. Prescott, P.V. Turnbull and R.R. Reeves. 1982. Preliminary notes on the occurrence of the North Atlantic right whale, *Eubalaena glacialis*, in the Bay of Fundy. *Rep. Int. Whal. Comm.* 32:407-411.
- Lien, J., R. Sears, G.B. Stenson, P.W. Jones, and I. Ni. 1989. Right whale (*Eubalaena glacialis*) sightings in waters off Newfoundland and Labrador, and the Gulf of St. Lawrence (1978-1987). *Can. Field-Nat.* 103:91-93.
- Lien, J., S. Todd, and J. Guigne. 1990. Inferences about perception in large cetaceans, especially humpback whales, from incidental catches in fixed fishing gear, enhancement of nets by "alarm" devices and the acoustics of fishing gear. In: Thomas, J. and R. Kastelien (Eds). In Press. Plenum Press, New York, NY. *Sensory Abilities of Cetaceans*.
- Lipton, B. 1975. Whaling days in New Jersey. *Newark Mus. Quart.* 26(2-3): 1-72.
- Mayo, C.A. and M.V. Marx. 1990. Surface foraging behavior of the northern right whale, *Eubalaena glacialis*, and associated zooplankton characteristics. *Can. J. Zool.* 68:2214-2220

- Malme, C.I., P.R. Miles, G.W. Miller, W.J. Richardson, D.G. Roseneau, D.H. Thomson, and C.R. Greene. 1989. Analysis and ranking of the acoustic disturbance potential of petroleum industry activities and other sources of noise in the environment of marine mammals in Alaska. Rept. No. 6945 prepared by BBN for U.S. Dept of the Interior, MMS under Contract 14-12-0001-30365. 293 pp.
- Maury, M.F. 1852. Whale chart of the world, (The wind and current charts), Series F, Washington, D.C.
- Mead, J.G. 1986. Twentieth-century records of right whales (*Eubalaena glacialis*) in the northwestern Atlantic Ocean. pp. 109-120. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Mitchell, E.D. 1975. Trophic relationships and competition for food in Northwest Atlantic whales. Proc. Canad. Soc. Zool. Ann. Mtg. 1974:123-133.
- Müller. 1776. Zool. Danicae Prodr., p.7.
- Müller, J. 1954. Observations on the orbital region of the skull of the Mystacoceti. Zool. Mededelingen 32(23):279-290.
- Murison, L.D., and D.E. Gaskin. 1989. The distribution of right whales and zooplankton in the Bay of Fundy, Canada. Can. J. Zool. 67: 1411-1420.
- Nemoto, T. 1963. Some aspects of the distribution of *Calanus cristatus* and *C. plumchrus* in the Bering Sea and its neighboring waters, with reference to the feeding of baleen whales. Sci. Rep. Whal. Res. Inst. 17:157-170.
- Nishiwaki, M. 1967. Distribution and migration of marine mammals in the north Pacific area. Bull. Ocean. Res. Inst. 1:1-64.
- NMFS. 1988. Proceedings of the Workshop to Review and Evaluate Whale Watching Programs and Management Needs. 53 pp.
- NMFS. 1991. Endangered Whales: Status Update. 52 pp.
- Omura, H. 1958. North Pacific right whales. Sci. Rep. Whales Res. Inst. 13:1-52.
- Omura, H. 1986. History of right whale catches in the waters around Japan. pp. 35-41. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Omura, H., S. Ohsumi, T. Nemoto, K. Nasu, and T. Kasuya. 1969. Black right whales in the North Pacific. Sci. Rept. Whales Res. Inst. 21:1-87.
- Payne, R. and S. McVay. 1971. Songs of humpback whales. Science 173: 585-597.
- Payne, R., V. Rowntree, J.S. Perkins, J.S. Cooke, and K. Lankester. pp. 271-278. In: Hammond, P.S., S.A. Mizroch, and G.P. Donovan (Eds). 1990. Individual Recognition of Cetaceans: Use of photo-identification and other techniques to estimate population parameters. Rpts of the IWC; Special Issue No. 12. Cambridge, England. 440 pp.
- Reeves, R.R., J.G. Mead and S.K. Katona. 1978. The right whale, *Eubalaena glacialis*, in the Western North Atlantic. Rep. Int. Whal. Comm. 28: SC/29/Doc 44. pp. 303-312.

- Reeves, R.R., and E.D. Mitchell. 1986a. American Pelagic whaling for right whales in the North Atlantic: pp. 221-254. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Reeves, R.R., and E.D. Mitchell. 1986b. The Long Island, New York, right whale fishery: 1650-1924. pp. 201-220. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Rice, D.W. 1974. Whales and whale research in the eastern North Pacific. pp. 170-195 In: W.E. Schevill (ed.) The Whale Problem. A Status Report. Cambridge, MA., Harvard Univ. Press. 419 pp.
- Rice, D.W. and C.H. Fiscus. 1968. Right whales in the southeastern North Pacific. *Nor. Hvalfangst-Tid.* 57(5):105-107.
- Rice, D.W. and A. Wolman. 1982. Whale census in the Gulf of Alaska, June to August 1980. *Rep. Int. Whal. Comm.* 32:1-11.
- Richardson, W.J., C.R. Greene, J.P. Hickie, and R.A. Davis. 1983. Effects of offshore petroleum operations on cold water marine mammals. A literature review. API Rept. No. 4370. Am. Petrol. Inst. Washington, D.C. 248 pp.
- Scarff, J.E. 1986. Historic and present distribution of the right whale (*Eubaleana glacialis*) in the eastern North Pacific south of 50°N and east of 180°W. pp. 43-63. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Schaeff, C., S. Kraus, M. Brown, J. Perkins, R. Payne, D. Gaskin, P. Boag, and B. White. 1991. Preliminary analysis of mitochondrial DNA variation within and between right whale species *Eubalaena glacialis* and *Eubalaena australis*. pp. 217-223. In: Hoelzel, A.R. (Ed). 1991. Genetic ecology of whales and dolphins. Rpts. of the IWC; Special Issue No. 13. Cambridge, England. 311 pp.
- Schevill, W.E. 1986. Right Whale Nomenclature, Appendix 5, p. 19. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Schevill, W.E. and K.E. Moore. 1983. Townsend's unmapped North Atlantic right whales (*Eubalaena glacialis*). *Breviora* 476: 1-8.
- Sergeant, D.E. 1966. Populations of large whale species in the western North Atlantic with special reference to the fin whale. *Fish. Res. Bd. Canada, ABS Circ. No. 9*, 13p.
- Starbuck, A. 1878. History of the American whale fishery from its earliest inception to the year 1876. *Rept. of the U.S. Comm. on Fish and Fisheries, Part 4*, Washington, D.C. p. 1-768.
- Tomilin, A.G. 1957. Mammals of the U.S.S.R. and adjacent countries: Vol. IX. Israel Program for Scientific Translation Ltd. Cat. No. 1124. 717 pp.
- Townsend, C.H. 1886. Present condition of the California gray whale fishery. *Bull. U.S. Fish Comm.* 6:346-350.

- Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. *Zoologica* (N.Y.) 19:1-50.
- Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. *Mar. Mamm. Sci.* 2(4):251-262.
- Watkins, W.A. and W.E. Schevill. 1976. Right whale feeding and baleen rattle. *J. Mamm.* 57(1): 58-66.
- Watkins, W.A. and W.E. Schevill. 1979. Aerial observation of feeding behavior in four baleen whales: *Eubalaena glacialis*, *Balaenoptera borealis*, *Megaptera novaeangliae*, and *Balaenoptera physalus*. *J. Mamm.* 60 (1): 155-163.
- Webb, R.L. 1988. On the Northwest, commercial whaling in the Pacific Northwest, 1790-1967. Univ. of British Columbia Press, Vancouver. 425 pp.
- Wishner, K., E. Durbin, A. Durbin, M. Macaulay, H. Winn, and R. Kenney. 1988. Copepod patches and right whales in the Great South Channel off New England. *Bull. Mar. Sci.* 43(3):825-844.
- Winn, H.E. 1984. Development of a right whale sighting network in the southeastern U.S. NTIS Publication No. PB84 240548. 12 pp.
- Winn, H.E., C.A. Price, and P.W. Sorenson. 1986. The distributional biology of the right whale (*Eubalaena glacialis*) pp. 129-138. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.

APPENDICES

Appendix A

Members of the Right Whale Recovery Team

Chairman
Mr. Hans Neuhauser
The Georgia Conservancy

Mr. Douglas W. Beach
National Marine Fisheries Service
Northeast Region

Dr. Thomas W. French
Natural Heritage and Endangered Species
Division of Fisheries and Wildlife
State of Massachusetts

Dr. David E. Gaskin
Department of Zoology
University of Guelph

Dr. Rennie S. Holt
National Marine Fisheries
Southwest Fisheries Science Center

Dr. Steve Katona
Department of Biology
College of the Atlantic

Dr. Robert D. Kenney
Graduate School of Oceanography
University of Rhode Island

Mr. Scott D. Kraus
New England Aquarium

Dr. Roger Payne
Whale and Dolphin Conservation Society

Dr. Howard E. Winn
Graduate School of Oceanography
University of Rhode Island

Appendix B

Glossary and List of Abbreviations

AFIP - Armed Forces Institute of Pathology

Appropriately Photographed - Adequate documentation of the head, body, and flukes.

CCS - Center for Coastal Studies

CeTAP - Cetacean and Turtle Assessment Program

CMR - Code of Massachusetts Regulations

Corps - U.S. Army Corps of Engineers

DOD - Department of Defense

DFO - Department of Fisheries and Oceans (Canada)

DOS - Department of State

DOT - Department of Transportation

EPA - Environmental Protection Agency

FMC - Fisheries Management Council(s)

IWC - International Whaling Commission

MA - Massachusetts

MARMAP - Marine Resources Monitoring Assessment and Prediction

MMEP - Marine Mammal Events Program of the Smithsonian Institution

MMS - Minerals Management Service

NEA - New England Aquarium

NMFS - National Marine Fisheries Service

NMNH - National Museum of Natural History, Smithsonian Institution

North Atlantic Right Whale Consortium - A group of institutions headed by the University of Rhode Island consisting of Woods Hole Oceanographic Institute, New England Aquarium, and the Center for Coastal Studies

NSF - National Science Foundation

OCS - Outer Continental Shelf

SCOPEX - South Channel Oceanographic Productivity Experiment

URI - University of Rhode Island

USCG - U.S. Coast Guard

Appendix C

North Atlantic Implementation Schedule and Cost Estimates

Priorities in Column 3 of the following Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to identify those actions necessary to prevent extinction.

(► indicates a Priority 1 Objective).

Priority 2 - An action that must be taken to prevent a significant decline in population numbers, habitat quality or other significant negative impacts short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Some tasks can be conducted/accomplished concurrently. As recovery efforts continue these can be further defined. This implementation schedule defines individual tasks to emphasize their importance in the recovery effort.

Not all tasks will begin at the same time. Funding is estimated in years for the task to be completed after task implementation has begun, not with approval of the recovery plan.

Abbreviations used in "Responsible Entities" can be found in Appendix B.

NORTH ATLANTIC IMPLEMENTATION SCHEDULE

RECOVERY PLAN TASK	OBJECTIVE #	PRIORITY	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
IDENTIFY THOSE RESPONSIBLE FOR REDUCING SHIP COLLISIONS WITH NORTHERN RIGHT WHALES IN THE FOLLOWING SIX AREAS.										
▶ BROWNS/BACCARO BANKS (CANADIAN JURISDICTION)	1111	1	2 YEARS	NMFS, DOS, DFO	20	20				COLLECT INFORMATION ON POTENTIAL CONFLICTS BETWEEN VESSELS AND WHALES
▶ BAY OF FUNDY (CANADIAN JURISDICTION)	1112	1	2 YEARS	NMFS, DOS, DFO	20	20				
▶ CAPE COD BAY	1113	1	1 YEAR	NMFS	10					
▶ GREAT SOUTH CHANNEL	1114	1	1 YEAR	NMFS	10					
▶ SOUTHEASTERN U.S. (CHARLESTON, SOUTH CAROLINA TO MIAMI, FLORIDA)	1115	1	3 YEARS	NMFS, CORPS, DOD, USGC	50	50				
▶ MIGRATORY ROUTES BETWEEN THE ABOVE HIGH USE AREAS.	1116	1	1 YEAR	NMFS, HMS, USCG COE, DOD, DOT	25					
▶ ANALYZE KNOWN KILLS AND SCARRING PATTERNS ON LIVING NORTHERN RIGHT WHALES TO IDENTIFY VESSEL ACTIVITIES THAT PUT NORTHERN RIGHT WHALES AT RISK OF COLLISION.	112	1	ONGOING	NMFS	30	25	15	5	5	
EDUCATE MARINERS ABOUT NORTHERN RIGHT WHALES BY:										
▶ A) PUBLISHING SPECIAL WARNINGS OF SEASONAL HIGH-USE NORTHERN RIGHT WHALE AREAS.	1211	1	ONGOING	NMFS, USCG, DOD, DOT	5	5	5	5	5	ONGOING IN ALL AREAS
▶ B) SHOWING SEASONAL HIGH-USE NORTHERN RIGHT WHALE AREAS WITHIN SHIPPING LANES ON NAUTICAL CHARTS.	1212	2	2 YEARS	NOAA, NMFS, USCG, DOT	25	15				
▶ C) DEVELOPING AND DISTRIBUTING VIDEO TAPES TO HARBOR PILOTS WHERE APPROPRIATE.	1213	1	2 YEARS	NMFS, USCG	20	10				
▶ IMPLEMENT APPROPRIATE CONTROLS ON SHIP OPERATIONS AND DESIGN.	122	1	3 YEARS	NMFS, USCG, DOD	10	10	10			
▶ VIGOROUSLY ENFORCE WHALE-PROTECTING LAWS.	123	1	ONGOING	NMFS, USCG	10	10	10	10	10	
										INCLUDES ALL OBJECTIVES UNDER 122

RECOVERY PLAN TASK		OBJECTIVE PRIORITY #	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
IMPLEMENT APPROPRIATE SEASONAL OR GEOGRAPHIC REGULATIONS FOR USE OF CERTAIN FISHING GEAR IN THE FOLLOWING NORTHERN RIGHT WHALE HABITATS:										
▶ BAY OF FUNDY (CANADIAN JURISDICTION)	1311	1	3 YEARS	NMFS, DOS, DFO	10	10	10			CONDUCT WORKSHOPS AND OUTREACH PROGRAMS
▶ SOUTHERN NOVA SCOTIA SHELF (CANADIAN JURISDICTION)	1312	1	3 YEARS	NMFS, DOS, DFO	10	10	10			
JEFFREYS LEDGE AND THE MAINE COAST	1313	2	2 YEARS	NMFS, FMC, STATES	5	5				
CAPE COD BAY AND MASSACHUSETTS BAY	1314	2	2 YEARS	NMFS, FMC, MASSACHUSETTS	5	5				
GREAT SOUTH CHANNEL	1315	2	2 YEARS	NMFS, FMC, STATES	5	5				
▶ SOUTHEASTERN U.S.	1316	1	2 YEARS	NMFS, FMC, STATES	15	15				
DEVELOP OR MODIFY FISHING GEAR TO REDUCE THE THREAT OF ENTRAPMENT OR ENTANGLEMENT.	133	2	ONGOING	NMFS, FMC	15	15	15	15	15	
▶ REDUCE OR ELIMINATE ENVIRONMENTAL POLLUTION IN KNOWN RIGHT WHALE HABITAT.	14	1	ONGOING	EPA, CORPS, STATES	50	50	50	50	50	
EVALUATE EXISTING DATA REGARDING CONTAMINANT EFFECTS ON RIGHT WHALES AND THEIR PREY.	141	2	ONGOING	NMFS, EPA	30	30	30	30	30	
DESIGN AND CONDUCT STUDIES TO UNDERSTAND THE EFFECTS OF CONTAMINANTS ON NORTHERN RIGHT WHALES AND THEIR HABITAT AND CRITICAL LEVELS.	142	2	5 YEARS	NMFS, EPA	50	50	50	50	50	
MONITOR THE LEVELS OF THE CONTAMINANTS IDENTIFIED IN 141 WITHIN THE NORTHERN RIGHT WHALE'S ENVIRONMENT.	143	2	ONGOING	EPA, NMFS	100	75	50	50	50	
▶ CONTINUE INTERNATIONAL BAN ON HUNTING AND OTHER DIRECTED TAKE.	15	1	ONGOING	NMFS, DOS	5	5	5	5	5	
IMPROVE AND MAINTAIN THE SYSTEM FOR REPORTING STRANDED OR DISTRESSED NORTHERN RIGHT WHALES.	21	2	2 YEARS	NMFS	15	15				

RECOVERY PLAN TASK	OBJECTIVE #	PRIORITY	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
DEVELOP AND IMPROVE PROGRAM FOR REPORTING AND HANDLING LIVE STRANDED OR DISTRESSED NORTHERN RIGHT WHALES BY:										
A) DEVELOPING A CENTRALIZED SYSTEM FOR RESCUING LIVE STRANDED OR DISTRESSED NORTHERN RIGHT WHALES.	221	2	2 YEARS	NMFS	25	25				
B) IDENTIFYING AREAS/FACILITIES AND TRANSPORTATION/CONTAINMENT SYSTEMS ABLE TO HANDLE REHABILITATION OF A LIVE NORTHERN RIGHT WHALE CALF.	222	2	2 YEARS	NMFS	10	10				
IMPROVE THE EXISTING PROGRAM TO MAXIMIZE DATA COLLECTED FROM DEAD NORTHERN RIGHT WHALES BY:										
A) ESTABLISHING DESIGNATED SALVAGE AND NECROPSY SITES AT STRATEGIC LOCATIONS ALONG THE ATLANTIC COAST.	231	2	ONGOING	NMFS, NMNH, AFIP	10	10	5	5	5	
B) DEVELOPING AND DISTRIBUTING INSTRUCTIONS FOR SECURING AND RETRIEVING FLOATING CARCASSES OF NORTHERN RIGHT WHALES.	232	2	ONGOING	NMFS, NMNH	15	10	5	5	5	
C) PERFORMING COMPREHENSIVE ANALYSES OF TISSUE SAMPLES.	233	2	ONGOING	NMFS, AFIP, NSF, EPA, MMS, NMNH	50	30	20	20	20	
D) DETERMINING CAUSES OF MORTALITY AND USING THIS INFORMATION TO REDUCE SUSCEPTIBILITY TO DEATH FROM THESE CAUSES.	234	2	ONGOING	NMFS, MMS, USCG, DOD, NMNH, AFIP	10	10	10	10	10	
ESTABLISH OR IDENTIFY FUNDING SOURCES FOR EMERGENCY RESCUE AND REHABILITATION EFFORTS	24	2	ONGOING	NMFS	10	10	10	10	10	
▶ PROTECT HABITATS IN U.S. WATERS ALREADY KNOWN TO BE OF SPECIAL IMPORTANCE TO THE NORTHERN RIGHT WHALE.	31	1	2 YEARS	NMFS	5	5				NMFS HAS REC. PETITION REQUES. DESIGNATION OF CRITICAL HABITAT
▶ PROMOTE CANADIAN ACTION TO PROTECT THE TWO KNOWN CRITICAL AREAS IN CANADIAN WATERS.	32	1	5 YEARS	NMFS, DOS, DFO	50	50	50	30	30	
PERIODICALLY REVIEW THE EFFECTIVENESS OF PROTECTIVE MEASURES - UPDATE AND/OR REVISE AS REQUIRED.	33	2	ONGOING	NMFS	5	5	5	5	5	

RECOVERY PLAN TASK	OBJECTIVE PRIORITY #	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
PROVIDE A HIGHER LEVEL OF PROTECTION IF REQUIRED FOR ANY OF THESE AREAS.	331	2	ONGOING	NMFS	5	5	5	5	
CONDUCT COMPREHENSIVE STUDIES OF NORTHERN RIGHT HABITAT USE PATTERNS AND MODIFY HABITAT PROTECTION STRATEGIES AS APPROPRIATE BY:									
A) DETERMINING DIFFERENCES IN HABITAT USE BY AGE, SEX, REPRODUCTIVE STATUS, OR INDIVIDUAL VARIATION.	3411	2	ONGOING	NMFS	50	35	25	25	15
B) INCREASING KNOWLEDGE OF NUMBERS OF ANIMALS PRESENT AND RESIDENCE TIMES IN KNOWN HABITAT AREAS.	3412	2	ONGOING	NMFS	150	150	100	100	80
C) DETERMINING ROUTES AND TIMING OF MIGRATION BETWEEN KNOWN HIGH-USE HABITATS.	3413	2	ONGOING	NMFS, MMS	130	80	80	80	50
UNDERSTAND THE FEEDING ECOLOGY OF NORTHERN RIGHT WHALES IN THE WESTERN NORTH ATLANTIC BY:									
A) COMPILING AND EVALUATING EXISTING DATA ON KNOWN AND POTENTIAL PREY AND COMPETITOR SPECIES.	3421	2	ONGOING	NMFS	5	10	10	5	5
B) REVIEWING AND REFINING ENERGETICS MODELS TO BETTER UNDERSTAND NORTHERN RIGHT WHALE FOOD REQUIREMENTS AND FEEDING STRATEGIES.	3422	2	ONGOING	NMFS	70	50	30	20	10
C) DESIGNING AND CONDUCTING STUDIES AS REQUIRED TO FILL GAPS IN KNOWLEDGE OF FEEDING REQUIREMENTS AS DETERMINED IN 3221 AND 3222.	3423	2	5 YEARS	NMFS	50	50	50	50	50
CHARACTERIZE HABITATS OF SPECIAL IMPORTANCE TO THE NORTHERN RIGHT WHALE AND PROTECT AS NECESSARY BY:									
A) COMPILING EXISTING PHYSICAL, CHEMICAL, BIOLOGICAL, AND METEOROLOGICAL DATA FOR KNOWN HIGH-USE HABITATS.	351	2	ONGOING	NMFS, MMS	80	50	30	30	30
B) DESIGNING AND CONDUCTING STUDIES AS REQUIRED TO MORE ACCURATELY CHARACTERIZE THESE HABITATS.	352	2	ONGOING	NMFS, MMS	30	50	50	30	30
COOPERATIVE EFFORTS AND EDUCATION									

RECOVERY PLAN TASK	OBJECTIVE #	PRIORITY	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
IDENTIFY AND PROTECT AS NECESSARY OTHER HABITAT(S) ESSENTIAL TO THE SURVIVAL AND RECOVERY OF THE WESTERN NORTH ATLANTIC RIGHT WHALE POPULATION BY:										
A) LOCATING AND PROTECTING THE STILL UNKNOWN WINTERING AREA(S) OF THE POPULATION.	361	1	ONGOING	NMFS, MMS	150	120	100	75	60	
B) REVIEWING HISTORICAL CATCH AND SIGHTING DATA TO IDENTIFY OTHER POSSIBLE FEEDING, CALVING, OR BREEDING AREAS.	362	2	3 YEARS	NMFS	20	30	20			
C) EXAMINING EXISTING OCEANOGRAPHIC DATA FOR LIKELY AREAS BASED ON THE RESULTS OF HABITAT CHARACTERIZATION STUDIES.	363	2	3 YEARS	NMFS	25	20	15			
D) DESIGNING AND CONDUCTING SURVEYS OF LIKELY WINTERING HABITATS AND OTHER AREAS.	364	2	4 YEARS	NMFS, OTHER AGENCIES AS APPROPRIATE	130	120	100	90		
MONITOR THE POPULATION SIZE AND TRENDS IN ABUNDANCE BY:										
A) DESIGNING AND IMPLEMENTING STUDIES TO ESTABLISH THE GENETIC VARIATION OF THE NORTHERN RIGHT WHALE.	41	1	5 YEARS	NMFS, MMS, NSF	100	75	75	50	50	
B) MAINTAINING THE NORTHERN RIGHT WHALE PHOTO-IDENTIFICATION CATALOG.	42	2	ONGOING	NMFS	50	50	50	50	50	
C) MAINTAINING THE NORTHERN RIGHT WHALE SIGHTING DATABASE.	43	2	ONGOING	NMFS	40	30	25	25	25	
D) CONTINUING A PROGRAM TO MONITOR ANNUAL REPRODUCTIVE SUCCESS.	44	2	ONGOING	NMFS, MMS	50	50	50	50	50	
E) DESIGNING AND IMPLEMENTING OTHER PROGRAMS FOR POPULATION MONITORING.	45	2	ONGOING	NMFS, MMS	50	50	30	30	30	
F) IDENTIFYING PRE-EXPLOITATION POPULATION NUMBERS FOR THE WESTERN NORTH ATLANTIC STOCK.	46	3	5 YEARS	NMFS	20	20	10	10	10	
G) ENCOURAGING DEVELOPMENT OF NEW TECHNOLOGY USEFUL FOR POPULATION MONITORING.	47	2	ONGOING	NMFS, MMS, COE, EPA	250	150	100	100	75	

RECOVERY PLAN TASK	OBJECTIVE #	PRIORITY	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
▶ ADOPT REGULATIONS ON WHALE WATCHING.	51	1	1 YEAR	NMFS	5					
DEVELOP AND CONTINUE A VIABLE RESEARCH PROGRAM TO INVESTIGATE AND DETERMINE THE EFFECTS OF WHALE WATCHING ON NORTHERN RIGHT WHALES BY:										
▶ A) EVALUATING THE SIGNIFICANCE OF SHORT-TERM EFFECTS OF DISTURBANCE.	521	1	3 YEARS	NMFS	60	60	60			
▶ B) EVALUATING LONG-TERM EFFECTS OF DISTURBANCE.	522	1	ONGOING	NMFS	30	30	30	30	30	
DEVELOP OR CONTINUE A VIABLE RESEARCH PROGRAM TO INVESTIGATE THE EFFECTS OF WHALE WATCHING.	523	2	2 YEARS	NMFS	30	30				
ESTABLISH A PROGRAM TO IMPROVE THE EDUCATIONAL ASPECTS OF WHALE WATCHING.	524	2	5 YEARS	NMFS	30	30	30	30	30	
IMPLEMENT APPROPRIATE CONTROLS ON ACTIVITIES WHICH MAY RESULT IN INTERACTIONS BY:										
A) DETERMINING APPROPRIATE MINIMUM APPROACH DISTANCES.	531	2	2 YEARS	NMFS	25	25				
B) DETERMINING IF MULTIPLE PLATFORM OBSERVATIONS OF A WHALE INCREASES ADVERSE EFFECTS.	532	2	2 YEARS	NMFS	25	25				
C) DETERMINING IF CERTAIN VESSEL TYPES HAVE MORE ADVERSE EFFECTS ON WHALES THAN DO OTHER VESSEL TYPES.	533	2	2 YEARS	NMFS	25	25				
D) DETERMINING "OPTIMAL" APPROACH GEOMETRIES, SPEEDS AND OPERATIONAL PATTERNS FOR APPROACHING WHALES.	534	3	2 YEARS	NMFS	25	25				
IDENTIFY MANAGEMENT OPTIONS, IF ANY, WHICH COULD REDUCE EFFECTS OF WHALE WATCHING.	535	2	ONGOING	NMFS	5	5	5	5	5	

RECOVERY PLAN TASK		OBJECTIVE	PRIORITY	TASK	RESPONSIBLE	FY1	FY2	FY3	FY4	FY5	COMMENTS
		#		DURATION	ENTITIES	\$K	\$K	\$K	\$K	\$K	
COORDINATE FEDERAL, STATE, INTERNATIONAL, AND PRIVATE EFFORTS TO IMPLEMENT THIS RECOVERY EFFORT BY:											
A)	DESIGNATING AN IMPLEMENTATION COORDINATOR TO FACILITATE RECOVERY PLAN IMPLEMENTATION	61	2	ONE TIME	NMFS						
B)	ESTABLISHING AN IMPLEMENTATION TEAM WITH REPRESENTATIVES OF FEDERAL, STATE, AND PRIVATE AGENCIES, INCLUDING FOREIGN AGENCIES WHEN APPROPRIATE TO ADDRESS AND RESPOND TO LEAD AGENCY RESPONSIBILITIES.	62	2	ONGOING	NMFS	35	25	25	25	25	SHOULD BE COORDINATED WITH OTHER RECOVERY PLANS WHEN APPROPRIATE
C)	IDENTIFYING, AT AN APPROPRIATE TIME, REPRESENTATIVES OF INVOLVED AGENCIES AND THE SCIENTIFIC COMMUNITY TO PERIODICALLY REVIEW AND UPDATE THIS RECOVERY PLAN.	63	2	2 YEARS	NMFS			15	15		

Appendix D

North Pacific Implementation Schedule and Cost Estimates

Priorities in Column 3 of the following Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to identify those actions necessary to prevent extinction.

(► indicates a Priority 1 Objective).

Priority 2 - An action that must be taken to prevent a significant decline in population numbers, habitat quality or other significant negative impacts short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Some tasks can be conducted/accomplished concurrently. As recovery efforts continue these can be further defined. This implementation schedule defines individual tasks to emphasize their importance in the recovery effort.

Not all tasks will begin at the same time. Funding is estimated in years for the task to be completed after task implementation has begun, not with approval of the recovery plan.

Abbreviations used in "Responsible Entities" can be found in Appendix B.

NORTH PACIFIC IMPLEMENTATION SCHEDULE

RECOVERY PLAN TASK	OBJECTIVE #	PRIORITY	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
INITIATE STUDIES TO DETERMINE THE POPULATION SIZE AND MONITOR TRENDS IN ABUNDANCE OF THE NORTH PACIFIC RIGHT WHALE.										
DESIGN AND CONDUCT STUDIES TO DETERMINE THE POPULATION SIZE OF THE NORTH PACIFIC POPULATION.	11	3	5 YEARS	NMFS, MMS, FOREIGN GOVERNMENTS	250	250	250	250	250	
DESIGN AND IMPLEMENT STUDIES WHICH CAN BE CONDUCTED IN COORDINATION WITH EXISTING RESEARCH PROGRAMS.	12	2	5 YEARS	NMFS, MMS	150	150	100	100	100	
ESTABLISH AND MAINTAIN A NORTH PACIFIC RIGHT WHALE PHOTOIDENTIFICATION CATALOG.	13	2	5 YEARS	NMFS	100	75	75	75	50	
MAINTAIN A NORTH PACIFIC RIGHT WHALE SIGHTING DATABASE.	14	2	5 YEARS	NMFS	70	50	50	30	30	
DESIGN AND IMPLEMENT OTHER PROGRAMS FOR POPULATION MONITORING.	15	2	5 YEARS	NMFS	50	50	30	30	30	
IDENTIFY PRE-EXPLOITATION POPULATION NUMBERS FOR THE NORTH PACIFIC RIGHT WHALE.	16	3	3 YEARS	NMFS	40	30	20			
IDENTIFY AND PROTECT HABITATS ESSENTIAL TO THE SURVIVAL AND RECOVERY OF THE NORTH PACIFIC RIGHT WHALE BY:										
IDENTIFYING AND PROTECTING AS NECESSARY HABITAT(S) ESSENTIAL TO THE SURVIVAL AND RECOVERY OF THE NORTH PACIFIC RIGHT WHALE.	21	2	5 YEARS	NMFS, MMS	500	300	250	250	250	

RECOVERY PLAN TASK	OBJECTIVE #	PRIORITY	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
CHARACTERIZING THESE HABITATS SO SIMILAR AREAS CAN BE SEARCHED FOR NORTH PACIFIC RIGHT WHALES AND BE PROTECTED AS NECESSARY.	22	2	5 YEARS	NMFS	100	100	100	100	100	
REVIEWING HISTORICAL CATCH AND SIGHTING DATA TO IDENTIFY OTHER POSSIBLE FEEDING, CALVING, OR BREEDING GROUNDS.	23	2	3 YEARS	NMFS	30	30	30			
IDENTIFYING MIGRATORY ROUTES BETWEEN THE SUMMER AND WINTERING AREAS.	24	2	5 YEARS	NMFS	150	150	100	100	100	
COLLECT AND ANALYZE INFORMATION ON THE AREAS AND SEASONS WHERE POTENTIAL CONFLICTS EXIST BETWEEN VESSEL TRAFFIC AND NORTH PACIFIC RIGHT WHALES, AND THE TYPES OF VESSELS INVOLVED.										
EDUCATE MARINERS ABOUT NORTH PACIFIC RIGHT WHALES.	31	3	3 YEARS	NMFS	30	30	20			
DEVELOP AND DISTRIBUTE VIDEO TAPES, SIMILAR TO THE ONE BEING USED BY HARBOR PILOTS IN SAVANNAH AND BRUNSWICK, GEORGIA, WHERE APPROPRIATE.	32	3	2 YEARS	NMFS, USCG	30	20				
INTERNATIONAL COOPERATION.	33	2	5 YEARS	NMFS, DOS	50	50	50	50	50	
VIGOROUSLY ENFORCE WHALE-PROTECTING LAWS.	4	2	5 YEARS	NMFS, USCG	20	20	20	20	20	
CONTINUE INTERNATIONAL BAN ON HUNTING AND OTHER DIRECTED TAKE.	5	2	5 YEARS	NMFS, DOS	10	10	10	10	10	
REDUCE OR ELIMINATE INJURY AND MORTALITY CAUSED BY FISHING GEAR BY:										
DOCUMENTING INDICATIONS OF FISHING GEAR INTERACTIONS WHEN NORTH PACIFIC RIGHT WHALES ARE SIGHTED AND IMPLEMENTING APPROPRIATE SEASONAL OR GEOGRAPHIC REGULATIONS FOR USE IN CERTAIN NORTH PACIFIC RIGHT WHALE HABITATS.	61	3	5 YEARS	NMFS	30	30	30	30	30	
MODIFYING OR DEVELOPING FISHING GEAR TO REDUCE THE THREAT OF ENTRAPMENT OR ENTANGLEMENT.	62	3	5 YEARS	NMFS	50	50	50	50	50	

RECOVERY PLAN TASK	OBJECTIVE #	PRIORITY	TASK DURATION	RESPONSIBLE ENTITIES	FY1 \$K	FY2 \$K	FY3 \$K	FY4 \$K	FY5 \$K	COMMENTS
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MAXIMIZE EFFORTS TO ACQUIRE SCIENTIFIC INFORMATION FROM DEAD OR STRANDED NORTH PACIFIC RIGHT WHALES BY:

ESTABLISHING AND MAINTAINING A SYSTEM FOR REPORTING STRANDED OR DISTRESSED NORTH PACIFIC RIGHT WHALES.

71	2	3 YEARS	MMFS, USCG	50	50	30				
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ESTABLISHING AND MAINTAIN A PROGRAM TO MAXIMIZE DATA COLLECTED FROM DEAD NORTH PACIFIC RIGHT WHALES BY PERFORMING COMPREHENSIVE ANALYSES OF TISSUE SAMPLES.

72	2	5 YEARS	MMFS, EPA, NOS, MMS	150	100	50	50	50	50	
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Appendix E

Other Sources of Information on the North Atlantic Right Whale

- Allen, K. R. 1980. Conservation and Management of Whales. Washington Sea Grant Publ., Univ. Washington Press, Seattle. 107 pp.
- Andrews. 1908. Notes upon the external and internal anatomy of *Balaena glacialis*. Bonn. Bull. Am. Mus. Nat. Hist., 24: 171-182.
- Best, P.B. 1970. Exploitation and recovery of right whales off the Cape Province. Div. Sea Fish. Invstg. Rep. 80. 20 pp.
- Best, P.B. 1982. Report on the sub-committee on protected species and aboriginal whaling. Rep. Int. Whal. Comm. 32:104-112.
- Best, P.B. 1987. Estimates of the landed catch of right (and other whalebone) whales in the American fishery, 1805-1909. Fishery Bull. 85(3) 403-418.
- Brown, C. W. and H.E. Winn. 1989. Relationship between the distribution pattern of right whales, (*Eubalaena glacialis*), and satellite-derived sea surface thermal structure in the Great South Channel. Cont. Shelf Res. 9(3):247-260.
- Brown, M. W., S.D. Kraus, and D.E. Gaskin. 1991. Reaction of northern right whales (*Eubalaena glacialis*) to skin biopsy sampling for genetic and pollutant analysis. pp. 82-89. In: Hoelzel, A.R. (Ed). 1991. Genetic ecology of whales and dolphins. Rpts. of the IWC; Special Issue No. 13. Cambridge, England. 311 pp.
- Caldwell, D.K. and M.C. Caldwell. 1971. Sounds produced by two rare cetaceans stranded in Florida. Cetology, No. 4, 6 p.
- Chapman, D.G., L.L. Eberhardt, and J.R. Gilbert. 1977. A Review of marine mammal census methods. NTIS Publication PB 265 547. U.S. Dept. of Commerce, Springfield, VA.
- Chapman, G.R. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. Univ. Calif. Public Stat. 1:131-160.
- Fairfield, C.P. 1990. Comparison of Abundance Estimation Techniques for the Western North Atlantic Right Whale (*Eubalaena glacialis*). pp. 119-133. In: Hammond, P.S., S.A. Mizroch, and G.P. Donovan (Eds). 1990. Individual Recognition of Cetaceans: Use of photo-identification and other techniques to estimate population parameters. Rpts of the IWC; Special Issue No. 12. Cambridge, England. 440 pp.
- Gambell, R. 1976. World whale stocks. Mammal Rev. 6:41-53.
- Gaskin, D.E. 1983. The Right Whale. A Status Report for the Committee on the Status of Endangered Wildlife in Canada.
- Holt, R.S., T. Gerrodette, and J.B. Cologne. 1985. Research vessel survey design for monitoring dolphin abundance in the Eastern Tropical Pacific, 1986-1990. NAFO SCR 85/80: 18 pp.
- Kenney, R.D., M.A.M. Hyman, and H.E. Winn. 1985. Calculation of stranding stocks and energetic requirements of the cetaceans of the northeastern U.S. outer continental shelf. (NOAA Tech. Mem. NMFS-F/NEC-4).

- Kraus, S.D., K.E. Moore, C.E. Price, M.J. Crone, W.A. Watkins, H.E. Winn and J.H. Prescott. 1986. pp. 145-152. The use of photographs to identify individual North Atlantic right whales (*Eubalaena glacialis*). In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Leatherwood, S., A.E. Bowles, and R.R. Reeves. 1983. Aerial surveys of marine mammals in the southeastern Bering Sea. U.S. Dept. Commer., NOAA, OCSEAP Final Rep. 42(1986): 147-490.
- Lowry, L.F., K.J. Frost, D.G. Calkins, G.L. Swartzman, and S. Hills. 1982. Feeding habits, food requirements, and status of Bering Sea marine mammals. Volume 1, Text. Final Report submitted to the North Pacific Fisheries Management Council, Anchorage, Alaska. pp. 1-292.
- Malme, C.I., P.R. Miles, C.W. Clark, P. Tyack, and J.E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Rept. No. 5366 from BBN to the U.S. Dept. of the Interior, MMS, under Contract AA851-CT2-39.
- Mitchell, E., V. M. Kozicki, and R.R. Reeves. 1986. Sightings of right whales, *Eubalaena glacialis*, on the Scotian Shelf, 1966-1972. pp. 83-108. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Murison, L.D. 1985. Feeding ecology of the North Atlantic Right Whale (*Eubalaena glacialis*) in the Bay of Fundy, Canada. Abstracts of the Sixth Biennial Conference on the Biology of Marine Mammals, Vancouver, B.C. Canada.
- Payne, R. 1972. Swimming with Patagonia's right whales. Natl. Geogr. Mag. 142(4): 576-687.
- Payne, R. 1986. Long Term behavioral studies of the southern right whale (*Eubalaena australis*). pp. 161-167. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Payne, R. and K. Payne. 1971. Underwater sounds of southern right whales. Zoologica 58: 159-165.
- Pike, G. 1962. Migration and feeding of the gray whale (*Eschrichtius gibbosus*). J. Fish. Res. Bd. Canada 19(5):815-838.
- Pike, G.C. and I.B. McAskie. 1969. Marine mammals of British Columbia. Fish. Res. Bd. Canada Bull. 171:1-54.
- Rice, D.W. 1983. Gestation period and fetal growth of the gray whale. Rept. Int. Whal. Comm. 33: 539-544.
- Richardson, W.J., R.S. Wells and B. Würsig. 1983. Disturbance responses of bowheads, 1982. P.117-215 In: W.J. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1982. Unpubl. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, VA 357p.
- Saayman, G.S. and C.K. Taylor. 1973. Some behaviour patterns of the southern right whale, *Eubalaena australis*. Z.Saugetierkunde, 38(3): 172-183.

- Schevill, W.E., W.A. Watkins, and K.E. Moore. 1986. Status of *Eubalaena glacialis* off Cape Cod pp.79-82. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Schevill, W.E., K.E. Moore, and W.A. Watkins. 1981. Right whale, *Eubalaena glacialis*, sightings in Cape Cod waters. WHOI Tech. Rept. WHOI-81-50; 1-16.
- Tabor, S. and P. Thomas. 1983. Calf development and mother-calf spatial relationships in southern right whales. *Animal Behavior* 30(4): 1072-1083.
- True, F.W. 1904. The whalebone whales of the western North Atlantic. *Smithsonian Contributions to Knowledge*, 33: 1-332, pls. 1-50.
- Wada, S. 1975. Indices of abundance of large-sized whales in the North Pacific in 1974 whaling season. Unpubl. report to the Sci. Comm., Int. Whal. Comm.
- Wada, S. 1981. Japanese whaling and whale sighting in the North Pacific 1979 season. *Rep. Int. Whal. Comm.* 31:783-792.
- Watkins, W.A. and W.E. Schevill. 1982. Observations of right whales, *Eubalaena glacialis*, in Cape Cod waters. *Fish. Bull.* 80(4): 875-880.
- Whitehead, H. and R. Payne. 1981. New techniques for measuring whales from the air. U.S. Dept. of Commerce NTIS PB81-161143. 36 pp.
- Winn, H.E., E.A. Scott, R.D. Kenney. 1985. Aerial Surveys for Right Whales in the Great South Channel, Spring 1984. NTIS Publ. No. PB85-207926.

Appendix F

Sources of Information on the Southern Right Whale

- Best, P.B. 1977. Report on Santa Catarina, Brasil, Whale Fishery 1954-1973. Programa de Pesquisa e Desenvolvimento Pesca do Brasil 1977.
- Best, P.B. 1981. The status of right whales (*Eubalaena glacialis*) off South Africa, 1969-1979. Invest. Rep. Sea Fish. Inst. S. Afr. 123: 1-44.
- Best, P.B. 1987. Right whales at Tristan da Cunha- a clue to the "non-recovery" of depleted whale stocks? Int. Whal. Comm. SC/39/PS4, 41 pp.
- Best, P.B. 1990a. Natural markings and their use in determining calving intervals in right whales off South Africa. S. Afr. Tydskr. Dierk. 25(2):114-123.
- Best, P.B. 1990b. Trends in the inshore right whale populations off South Africa, 1969-1987. Mar. Mamm. Sci. 6(2):93-108.
- Best, P.B. and M.A. Meyer. 1984. A survey for right whales at Tristan da Cunha and Gough Island. Int. Whal. Commn. SC/36/PS15.
- Camara, I.G. and J.T. Palazzo, Jr., 1984. New information on the presence of *Eubalaena glacialis* off southern Brazil. Int. Whal. Commn. SC/36/PS 19.
- Castello, H.P. and M.C. Pinedo. 1979. Southern right whales (*Eubalaena australis*) along the southern Brazilian coast, J. Mammal. 60 (2): 429-430.
- Cawthorn, M.W. 1982. Catch history and present status of right whales in the South West Pacific and New Zealand region. Int. Whal. Commn. SC/34/R11(D1).
- Clark, C. W. 1983. Acoustic communication and behavior of the southern right whale (*Eubalaena australis*). In: R. Payne (ed.) Communication and Behavior of Whales. AAAS Selected Symposium 76, Westview Press, Colorado.
- Clark, C.W. and J.M. Clark. 1980. Sound playback experiments with southern right whales (*Eubalaena australis*). Science 207: 663-665.
- Cooke, J., R. Payne, V. Rowntree and J. Perkins (in press). Population size, trends and reproductive parameters of right whales (*Eubalaena australis*) off Peninsula Valdes. Int. Whal. Commn. SC/A88/ID1.
- Cummings, S.C., J.F. Fish and P.O. Thompson. 1972. Sound production and other behavior of southern right whales, (*Eubalaena glacialis*). San Diego Soc. Nat. Hist. Trans. 17(1):1-14.
- Donnelly, B.G. 1967. Observations on the mating behavior of the southern right whale *Eubalaena australis*. S. Afr. J. Sci. 63(5): 176-181.
- Donnelly, B.G. 1969. Further observations on the southern right whale, *Eubalaena australis*, in South African waters. J. Reprod. Fert. Suppl. 6:347-352.
- Ellis, M. 1958. Aspectos da pesca da baleia no Brasil colonial. Rev. Hist. Sao Paulo, 14: 1-126.
- Ellis, M. 1969. A baleia no Brasil colonial. Ed. Melhoramentos, Ed. Univ. Sao Paulo, 14: 1-126.

- Goodall, R.N.P. and A.R. Galeazzi. 1986. Recent sightings and strandings of southern right whales off sub Antarctica South America and the Antarctic Peninsula. pp. 173-176. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Hamner, W.M., G.S. Stone, and B.S. Obst. 1988. Behavior of southern right whales, *Eubalaena australis*, feeding on the Antarctic krill, *Euphausia superba*. Fish. Bull. 86(1):143-150.
- Kawamura, A. 1978. An interim consideration on a possible interspecific relation in southern baleen whales from the viewpoint of their food habits. Rep. Int. Whal. Commn. 32: 503-513.
- Kenny, R.D., M.A.M. Hyman and H.E. Winn. 1985. Calculations of standing stocks and energetic requirements of the cetaceans of the northeastern U.S. outer continental shelf. NOAA Tech. Mem. NMFS-F/NEC-4.
- Masaki, 1977. (In: Palazzo, J.T., and N. Carter (updated). Projecto Baleia Franca, A report for the Brazilian Foundation for the Conservation of Nature (FBCN), 17 pp.
- Matthews, L.H. 1938. Notes on the southern right whale, *Eubalaena australis*. Discovery Repts. 17:169-182
- Miranda-Ribeiro, A.de. 1932. As pretensas especies de baleias lisas do Atlantico. Bol. Mus. Nac. Rio De Janeiro 8: 1-12.
- Oshumi, S. and F. Kasamatsu. 1982. Right whale strandings in the waters south of Western Australia in summer 1981/1982. Int. Whal. Commn. SC/34/PS 17.
- Ohsumi, S. and F. Kasamatsu. 1986. Recent off-shore distribution of the southern right whale in summer. pp. 177-185. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.
- Payne, R., O. Brazier, E.M. Dorsey, J.S. Perkins, V.J. Rowntree and A. Titus. 1983. External features in southern right whales (*Eubalaena australis*) and their use in identifying individuals. pp. 371-445. In: R. Payne (ed.), Communication and Behavior of Whales. AAAS Selected Symposium 76, Westview Press, Boulder, Colorado. 643 pp.
- Palazzo, J.T. and L.A. Carter. 1983. A caca de baleias no Brasil Fundacao Brasileira para a Conservacao da Natureza, Porto Alegre, 28 pp.
- Thomas, P.O. and S.M. Taber. 1984. Mother-infant interaction and behavior development in southern right whales (*Eubalaena australis*), Behavior.
- Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. Zoologica 19: 1-50.
- van Beneden. P.J. 1869. Les Baleines et leur distribution géographique. Bull. Acad. Bruxelles, Ser. 25: 9-21.
- Whitehead, H., R. Payne, and M. Payne. 1986. Population estimates for the right whales of Peninsula Valdes, Argentina, 1971-1976. pp. 169-171. In: Brownell Jr., R.L., P.B. Best, and J.H. Prescott (Eds). 1986. Right Whales: Past and Present Status. Rpts. of the IWC; Special Issue No. 10. Cambridge, England. 286 pp.